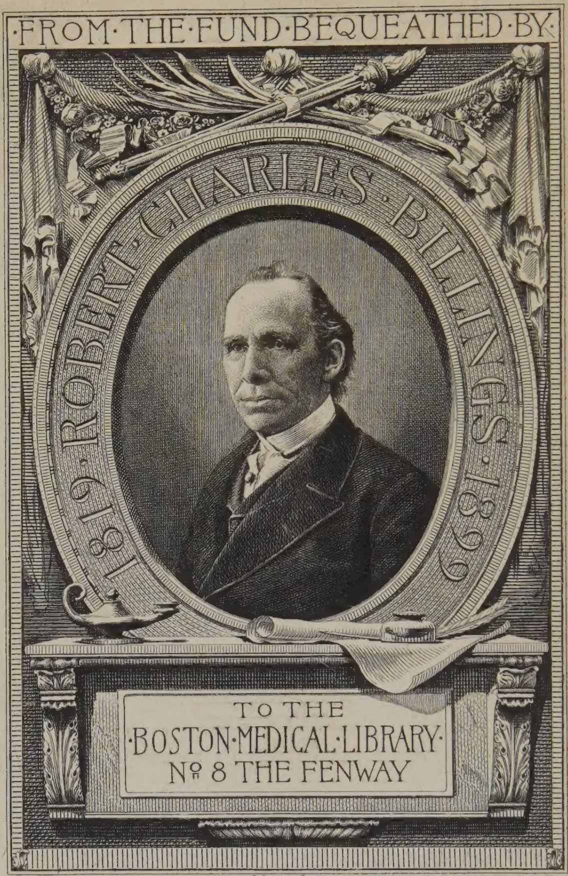
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INTERPRETERS
OF NATURE

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Essays by

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PREFACE

'I PROFESS both to learn and to teach,' said Harvey, 'not from the positions of philosophers, but from the fabric of nature.' Though these personal essays have been written at various times, and for different occasions, they have the common purpose of illustrating the fact that the science and art of Medicine is founded upon such observation and interpretation of Nature. They cannot serve as more than windows in the house of Medicine, but if opening inwardly they show something of its dimensions, beauty, and usefulness, and opening outwardly unfold upon a glorious landscape around and beyond, they will have served their end. Neither the inward nor outward vision is complete in itself, or yet a view of the whole. My heroes, living in different times and in many lands, had varied destinies to subserve; but all of them, whether explorers, teachers, poets, or practitioners, were interpreters of what their eyes had seen or their hands handled of the word of truth in their day. I hope the story of their labours, fragmentary though it be, may bring both contentment and encouragement to the reader.

G. N.

London, 1927.

CONTENTS

AND Nature, the old nurse, took
  The child upon her knee,
Saying: 'Here is a story-book
  Thy Father has written for thee.'

'Come, wander with me' she said
  'Into regions yet untrod;
And read what is still unread
  In the manuscripts of God.'

And he wandered away and away
  With Nature, the dear old nurse,
Who sang to him night and day
  The rhymes of the universe.

LONGFELLOW: *The Fiftieth Birthday of Agassiz.*
May 28th, 1857.

1. The Great Paduans

A CENTURY OF MEDICINE AT PADUA

¶ *Printed privately in* 1922, *and dedicated '*to The Medical Students of St. Bartholomew's Hospital, London, on the Staff of which William Harvey served as Physician,* 1609–1643*'.

A CENTURY OF MEDICINE AT PADUA

I STOOD alone, musing, in the deserted quadrangle of the old University at Padua on a sunny spring morning in the year of our Lord, 1921, twenty-five years after my first visit. The day had just begun. Outside the college gates the *contadini* unladened their panniers and displayed their goods, and 'the forum all alive with buyers and with sellers was humming like a hive'. But within there was peace, and my thoughts lingered on the academic past of this ancient Mother and of her illustrious children who had gone forth from this place to the ends of the earth.

I

It was in 1595 that Shakespeare put into the lips of Lucentio in 'The Taming of the Shrew' the words:

'Since for the great desire I had
To see fair Padua, nursery of arts,
I am arrived for fruitful Lombardy,
The pleasant garden of great Italy
. . . for I have Pisa left
And am to Padua come, as he that leaves
A shallow plash to plunge him in the deep
And with satiety seeks to quench his thirst.'

That was Padua's time of zenith as the first medical school of Italy, the country which was the birthplace of the medical university of the West. In the eleventh century Salerno, in the twelfth Bologna, and in the thirteenth Padua, as our American cousins say, 'blazed the trail' and prepared for the grand sweep of the Renaissance. Before the close of the Middle Ages, Italy possessed several examples of *universitas*, *schola*, or *studium generale*. The terms fluctuated as did the

students, and sometimes a pope and sometimes an emperor was patron. The condition of their existence—for they can scarce be said to have been founded—was dependent at first upon a variety of factors, not the least being the migration of students, the presence of libraries or teachers, national politics, commercial activities, and the willingness or otherwise of communes to receive them and provide accommodation at a low cost. Thus it came about that the University at Padua was a daughter of Bologna, initiated by a secession of students from the elder institution in 1222. Six years later a secondary migration took place to Vercelli beyond Milan, leaving the studium at Padua bereft, but not extinct, and faced with the tyranny of Ezzelino.

The revival of Padua came in 1260, due to the commune granting additional privileges and to further immigration from Bologna. In the fourteenth century the city conceded full university rights, and the studium developed into two universities, that of the jurists and that of the humanists—the *universitas artistarum* (including Medicine) being subordinate to the *universitas juristarum*, which was the larger, richer, and more dominant. In each university the students were enrolled as 'nations', each nation electing *concilarii*, who formed with the Rectors the executive of the University. In the fifteenth century collegia, or hostels, were established and Padua rose to be one of the great universities of the learned world. To it flocked men from all parts of Europe.

There were two particular reasons why Padua flourished as the seat of a university. First, she made her way in the Lombard league and became the head of the towns of the Marches. As in Florence so in Padua, there were internecine struggles between guelf and ghibelline, though the terms did not bear the same or even a continuous meaning. Chroniclers in the thirteenth and fourteenth centuries were anti-imperial

and yearned for a republican golden age. The House of Este (ancestors of our own royal dynasty), the families of Camposanpiero, of Romano, and of Carrara were destined at different times to rule in Padua, and their feuds and fortunes, and their conflicts with the people, spell out the long story of her struggle for independence. Victory placed her in a predominant position among her peers, and her favourable situation in the plains of Lombardy made her not only something of a health resort, to which her healing springs contributed, but a natural emporium for the wool- and thread-spinning industries. Thus in the thirteenth century she was ready to cultivate the arts of peace, and her Bishop, being then in Bologna, enticed two of its professors to join Albertus Magnus, the teacher of Thomas Aquinas, at Padua. So began the long line of distinguished teachers who made her fame.

The second reason for the ultimate emergence of the University at Padua was the protection of Venice. Between them there had been an intermittent history of concord and strife. In the fourteenth century 'great friendship' obtained, which ended in the absorption of Padua in the Venetian State, and her political history from the beginning of the fifteenth century onwards melts into the wider world of Venetian policy. Under the auspices of the Signory, learning at Padua began to sow seeds which in after years brought forth a rich harvest. Within her walls were gathered many of the great men of the time, and they fed her with seminal thought. The Signory patronized and encouraged them, paid part or all of their salaries, conferred honours and privileges on the Rector of Padua, and required students of Venice to study there. Indeed, as Dean Rashdall says, a period of study at Padua was 'required as a qualification for the exercise of public functions at Venice. Padua became, in fact, the university town, or, as M. Renan styled it, the *quartier latin* of Venice;

while the tolerance which under the protection of the great commercial Republic long defied the fury of the Catholic reaction, attracted an exceptional number of students, especially medical students, from England and the Protestant countries'. This substantial protection of Venice, lying as it did outside the Papal States, drew the most liberal teachers of Medicine to Padua, provided exceptional facilities and equipment for the anatomical dissection of the human body, shielded non-Catholic students from papal importunity, and was some surety of personal safety, unavailable in the German universities and even in other centres of learning in Italy.

There was yet one other far-reaching advantage which Padua enjoyed from its allegiance to the Republic. For 400 years Venice was Byzantine in thought and deed, and Byzantium had, as Sir Clifford Allbutt has reminded us, conserved and embalmed that strange amalgam, Greek Medicine—a broad and living stream of medical knowledge and experience derived from many remote sources. Byzantine influences reached Padua through Ravenna and through Venice. The tenth-century tomb of St. Mark at Venice was built in Byzantine style, modelled on Santa Sophia, and a vast storehouse of Byzantine relic and treasure; Venetian mosaics and sculptures were wrought by Greeks; its library is Greek in foundation; and before the early Renaissance, Venice was 'rather a Greek than an Italian city'. Its argosies had sailed the seas, and during the fourth Crusade, Doge Enrico Dandolo had won Constantinople, and thus the little Republic had vanquished the capital of the Eastern Empire. Though steady penetration of Greek inspiration had been going on for generations, the world influence of Venice dates from that event. After that she stood at the gate of the East. She became the carrier of the nations. Her ships exported the fruits of Lombardy and brought

back the timber of Dalmatia, the wares of Constantinople, the wines of the Aegean, the spices of Egypt, and the silks of Bagdad and the far Orient. And with this merchandise came back manuscripts and drugs.

Greece thus came to Venice 200 years before her university existed at Padua, and for four centuries the East had enriched her blood. Greek thought had, of course, influenced Italy from the days of the Greek colonies in Magna Graecia, 700 years before Christ, and here at Venice though the harvest was late the aftermath was sure. The restoration of Greek letters was prosecuted by a series of envoys, fugitives, merchants, and manuscript collectors. Cardinal Bessarion, a Greek, and the founder of the library of St. Mark, Leontius Pilatus, Aurispa, who brought 238 manuscripts to Venice in 1423, Francesco Filelfo, who brought another similar cargo four years later, Andrea Dandolo, the Doge, chronicler and historian, Professor of Law at Padua—these and many others came before the Fall of Constantinople in 1453 and before the Medici Academy had been established at Florence, and they filled the libraries of northern Italy with treasures of learning from the East.

Two circumstances made their work more than fleeting. In the fourteenth century Petrarch, 'the harbinger of day', as Gibbon calls him, and his friend Boccaccio, were there at hand, hungry to assimilate the Greek learning and fix it in Western culture. This they did. Their work was assisted and made durable by Aldus Manutius, who at the end of the next century set up his printing press at Venice and for the first time put into type some of the principal works of Greek literature. Thus it came about that at the end of the fifteenth century Padua, the University of Venice, found itself protected, equipped, ready and waiting for a golden age. The Republic and its merchants had secured for it independence of thought and study, the

tide of history travelling on the great road from the Adriatic coast had left its mark upon it, and liberal thinkers from other nations began to bring their glory and honour into it.

II

The unique advantages which Venice thus bestowed on Padua attracted our own fellow-countrymen to its University. Thomas Linacre, the founder of the College of Physicians of London, and the friend of Grocyn, John Colet, Sir Thomas More, and Erasmus, was one of the earliest of the English students to seek, at the end of the fifteenth century, a medical education at Padua. About 1485 he travelled to Italy with his former master, Selling of Canterbury, who had been appointed Ambassador by Henry VII at Rome. He visited Bologna and lived at the Court of Lorenzo the Magnificent at Florence, sharing with his two sons, Piero and Giovanni, the tuition of Politian and Chalcondyles. A year later, after visiting Rome, he went to Padua, where he took the degree of Doctor of Medicine. On his return he translated Aristotle and Galen, practised physic, became physician to the King, and with his friends introduced the New Learning to England. He was the outstanding type of medical humanist. Forty years later Edward Wootton followed his example. He subsequently became physician to Henry VIII and was the first of our English physicians to become an eminent naturalist and to include the study of zoology in the medical curriculum. Another of the early English students at Padua was John Caius, who worked under Montanus and Vesalius from 1539 to 1541, lodging in the house of the latter. He became illustrious both as anatomist and classical scholar. He was Professor of Greek in the University, co-operating with Realdus Columbus on the Greek text of Aristotle. In 1543 he visited the libraries of Italy, collecting

manuscripts with the object of bringing to England the fullest knowledge obtainable of Galen, of Celsus, and of the learning of the Renaissance. He was one of the re-founders of Gonville and Caius College, Cambridge, physician to Queen Elizabeth, and President of the College of Physicians. He was the first to introduce the study of practical anatomy in this country and the earliest publicly to teach it. He also was a naturalist and likewise an epidemiologist, having been the first to describe the sweating sickness. Gesner told the Queen that Caius was 'the most learned physician of his age'.

Half a century passed before the arrival of William Harvey, the most famous English student who went to Padua. He was the son of Thomas Harvey, yeoman, of Folkestone, and was born in 1578. He studied at Caius College, Cambridge, and reached Padua probably in 1600, attending the lectures of Fabricius in anatomy, Minadous in medicine, and Casserius in surgery. He was a member of the more aristocratic *universitas juristarum*, which admitted a few selected medical students to its ranks. He was elected a *concilarius* of the English 'nation' and his coat of arms, or *stemma*, was displayed in the courtyard of the University, where it was discovered in 1893—'Gulielmus Harveus Anglus'. He graduated in 1602 and probably returned to England. His Lumleian lectures on the Circulation of the Blood were delivered before the College of Physicians in the spring of 1616, the year of the death of Shakespeare and Cervantes, and his immortal book, 'Exercitatio Anatomica de motu cordis et sanguinis in animalibus', was published at Frankfort in 1628. He was appointed physician to St. Bartholomew's Hospital and to Charles I, and died in 1657.

Many English and Scotch students followed these great examples and crossed the Alps to study at Padua in the days before Leyden made disciples of Englishmen.

Their thirst for knowledge and their ambition to drink at Italian sources emboldened them to undergo the rigours of the enterprise. The journey itself, as we know from the colloquies of Erasmus, the journals of Luther, and the diary of Evelyn, was sufficiently tedious and formidable. The sufferings of Erasmus during his Continental travels are described by him to Linacre and Colet in his letters of 1500–1518, and nearly 150 years later Evelyn gives us an account of his return journey from Padua over the Simplon to London. In the time of Erasmus the mode of progress was by pack-horse, but Evelyn travelled also by coach. Whatever the mode, the monasteries, inns, and caravanserai furnished abundant discomfort, nor were the dangers of the way inconsiderable. Seebohm writes in the 'Oxford Reformers':

'One room serves for all comers, and in this one room, heated like a stove, some eighty or ninety guests have already stowed themselves—boots, baggage, dirt and all. Their wet clothes hang on the stove iron to dry, while they wait for their supper. There are footmen and horsemen, merchants, sailors, wagoners, husbandmen, children and women—sound and sick—combing their heads, wiping their brows, cleaning their boots, stinking of garlic, and making as great a confusion of tongues as there was at the building of Babel! At length, in the midst of the din and stifling closeness of this heated room, supper is spread—a coarse and ill-cooked meal—which our scholar scarcely dares to touch, and yet is obliged to sit out to the end for courtesy's sake. And when past midnight Erasmus is shown to his bed-chamber, he finds it to be rightly named—there is nothing in it but a *bed*; and the last and hardest task of the day is now to find between its rough unwashed sheets some chance hours of repose. So, almost in his own words, did Erasmus fare on his way to Italy.'

There were three principal routes from England to Padua, through France or Germany and over the Alps, or by sea to Genoa or Naples, or by sea to Venice and thence by road or canal. The usual route was that of the Simplon to Milan and thence by Bergamo, Brescia, and Verona. As the English student of the sixteenth century, taking this route, emerged from the hills and tramped or rode down the valley of the Bacchiglione he saw before him a brown-walled city of the plains, embowered in a garden of fields and vineyards. On the north he would see, within the walls, the solitary square spire of the thirteenth-century Church of the Eretami, immortalized by Mantegna and under the shadow of which Giotto painted his frescoes on the walls of the arena chapel; in the middle of the city rose the tower of the Palazzo del Podesta and to its right hand the domes and minarets of the glorious Franciscan Church of St. Antonio, the beloved friar, which had been the pride of Padua for 200 years, and which enshrines the work of Donatello; at the southern end he could not overlook the thirteenth-century fortress of Ezzelino on the wall, and the new campanile and glistening cupolas of St. Justina, the tomb of the saints; and for the rest the stranger would look down upon the grey roofs and bell-towers of a medieval town. He would pass into the city from the open country through the Porta Giovanni, under the shadow of the Duomo, or possibly over the Roman bridge through the forbidding and imperious Porta Molino. Once inside, he would find himself in dark, tortuous, and narrow streets, arched and lined with arcades (the *portici*) and over-hanging stories with small latticed windows.

The students' quarters lay to the east of the University, itself an old palace of the Maltraversi, situated in the heart of the city. Over the gateway was the Lion of St. Mark, the symbol of Venetian authority. The student passed into a magnificent courtyard surrounded

by a Doric colonnade and an upper loggia with Ionic columns—the loggia, the staircases, and the *aula magna*, the hall of the University, bearing on their walls the escutcheons, frescoed or sculptured, of former students. The University was nicknamed *Il bo*, perhaps because for a short period the palace had been used as the ox inn (*osteria del bo*), perhaps because the ox tax of the city was paid into the University coffers. Round about the University, then as now, were situated the class-rooms and technical laboratories, though in recent years the special medical and surgical departments have grown up in the vicinity of the hospital and Medical School in the Via del Falloppio, not far from the famous Physic Garden (and of which Falloppius was Keeper) founded in 1545, when the medieval herbals had come into use. Between the new buildings and the University still run the old narrow streets and arcades, which in the sixteenth century were crowded with the students of all nations. There still remains the ancient grandeur, the stigmata of the fourteenth century, and the symbols of the art, literature, and architecture of the Renaissance.

Arrived in Padua the wandering student of the sixteenth century was habituated to live under Spartan conditions. He was often poor, and, like Luther, begged his bread. Food though cheap was inadequate and ill-assorted; the houses were dismal, the lattice windows were often filled with sheets of linen; the beds were rough and unkempt; artificial light was expensive and poor; and there was an almost entire absence of healthy recreation and amusement—periodical wild orgies of students, 'horrid and petulant mirth', being the natural reaction. The medical session began on St. Luke's Day in the autumn of each year and lasted until August. During the ten months the whole human body was twice dissected in public by the Professor of Anatomy. These were formal occasions and the attendance became so large that a sort of wooden barrack or tabernacle

was built to serve as an anatomical theatre. In 1593, after Fabricius had been professor for thirty years, the Venetian authorities erected for him a small circular theatre which still exists, and here Harvey learned at his feet. The lectures on anatomy were delivered at nine o'clock in the morning, but others as early as six o'clock, and in the summer almost at daybreak. In the adjoining *aula magna* Galileo taught mathematics, though many of his popular astronomical lectures were delivered in the open air. The courtyard and the loggia hummed with the sound of many voices as groups of eager students discussed the rapid march of knowledge or the acquisition of new truth.

III

In its golden age Padua was a wonderful place. Both place and age stood at the dawn. For there and then the sixteenth century left an enduring imprint on the youth of all nations. One of the oldest cities in Italy, Patavia came under the Roman supremacy more than 200 years before Christ. In the fifth century it was destroyed by Attila the Hun, and the new city was taken by Agiluff the Lombard a hundred years later. From the Lombards it passed to the Franks, and during the guelf and ghibelline quarrels it alternately submitted to, or was conquered by, the tyrants and emperors or the Lombard league. In 1318 it took to itself as lord the head of the Carrara family, Jacopo, the patron of Petrarch, whose family ruled it until, in 1405, it became a republic, passing within the dominion of Venice in 1509. Under the shadow of the wings of the Lion of St. Mark, faithful and beautiful daughter of Venice it remained—the fair possessor of priceless treasure in art and architecture. There it stands to-day a monument and embodiment of the Middle Ages, lying in the rich and fertile plains which for centuries proved its snare—the snare which was predicted by Thucydides—between the Euganean

Hills and the sea, with all the Alps lying to the north, and to the south the long low stretch of the Marches away to Ravenna.

The glory which is Padua is, however, not in stone but in human endeavour: the birthplace of Livy and of Mantegna; the home of Petrarch; the land of the exile of Cosimo de Medici, patron of learning (accompanied by his friend Michelozzo, the Florentine sculptor) and of Palla Strozzi, the scholar and collector of Greek literature, and, last and greatest of the banished heroes, of Dante Alighieri; the workshop of Giotto and Donatello and Squarcione; the university of Dandolo, Vesalius, Frascatorius, Fabricius, and Galileo; the medical school of Linacre, Wootton, Caius, and Harvey; the haunt of Tasso and Ariosto and Boccaccio. What a galaxy! What immortal works of art, literature, and healing spring from the deeds of these men. Is it surprising that there should come to drink at this source a long procession of thirsty students and seekers of all nations, over the Alps and over the sea? Is it astonishing that Padua proved to be the foster-mother of some of the most dynamic of the new and living forces of Medicine, and which gave it renaissance when the light of morning broke over the West? And we may remember that, when daylight came, the Revival of Medicine passed in the direct line from Padua to Leyden, from Leyden under Boerhaave to Edinburgh, and from Edinburgh under Alexander Monro and William Cullen in the eighteenth century to the great medical schools of the New World—to Philadelphia, Columbia, and Harvard.

IV

(*a*)

Who were these prophets of Medicine at Padua and what did they do? The forerunner was a young

Belgian of 22 years of age, seeing visions. His name was Andreas Vesalius and he was born at Brussels in 1515, his father being apothecary to Charles V, and his mother an Englishwoman, named Isabella Crabbe. He was educated at Louvain and Leyden, and, naturally turning to medicine, studied anatomy under Sylvius in Paris. He served as a military surgeon in Flanders in 1536 and lectured in Italy in 1537. Subsequently in the same year he set his face to Venice to seek the patronage of its far-sighted rulers. In December he received the degree of Doctor of Medicine at their University of Padua and was entrusted with the teaching of anatomy. No sooner was he installed as professor than he introduced, in 1538, the new method of dissection and demonstration. This was the beginning of an incomparable century of Medicine at Padua. Instead of merely reading Galen—whose books had fixed medical knowledge for 1,400 years—Vesalius began to study the human body, to be guided by what he found and what he could see rather than by Galen. Nature, and not books, observation, and not authority, was the new method. The young men of Padua answered to the new voice and the new way, they saw instinctively that it was right, and an epoch began. The undisputed sway of the written word ended, and Vesalius declared in uncompromising fashion what he saw with his own eyes. 'I had to put my own hand to the business,' said he. Five years he thus spent in untiring labour, always with the vision yet not weaving webs of fancy, tracking out the structure of the human body as it actually is, dissecting it, demonstrating it to the crowds of students who hung on his words, and finally recording it in the folio pages of his 'Fabrica Humani Corporis', published at Basel in 1543, a lucid and orderly survey of acquired facts. 'This book' said Sir Michael Foster 'is the beginning, not only of modern anatomy, but of modern physiology. . . . Upon the publication of the

"Fabrica" the pall of authority was once and for ever removed.' It ended, for all time, the long reign of fourteen centuries of precedent; it began in a true sense the renaissance of Medicine. It added immensely to the knowledge of the body; it introduced a true method of science; above all, it engendered a new spirit.

Others had dissected before him in Alexandria, at Salerno, and elsewhere. Mundinus in 1315, and Carpi in 1521, had advanced the study of anatomy at Bologna and proved themselves the forerunners of Vesalius—the anatomical painters of the fifteenth century, Verrochio, da Vinci, Dürer, and Signorelli had used surface anatomy in the fine arts—but he it was who established and tilled the ground they had gained, and who opened the new book of Nature. 'Vesalius was the first to collect on a large scale' says Dr. Klebs 'the accumulated mass of anatomical facts he had obtained from his predecessors, notably Galen. By his own observations he was able to correct some of them and to add new ones. The descriptive, systematic, and especially graphic presentation of his great anatomic knowledge in a most impressive outward form was bound to exert a reformatory influence. This is without doubt his own intellectual deed.' His brilliant and vigorous advocacy brought down upon him envy and opposition, and in 1544 he left Padua to become Court physician to Charles V and subsequently to Philip. He died at Zante on his way back from a pilgrimage to the Holy Land in 1564—the year of the death of that other great anatomist, the painter Michelangelo. He was succeeded in the professorship by Realdus Columbus, one of his pupils, who, following Michael Servetus the Martyr, correctly described the pulmonary circulation. In 1551 Columbus was succeeded by Gabriel Falloppius, who studied the anatomy of the pelvis, and who in his turn was followed by Fabricius, Casserius, and Spigelius—all in the apostolic succession, all keeping alive the Vesalian fire,

all laying anew the foundations of anatomy and physiology. In England this was done by John Caius, friend and pupil of Vesalius at Padua.

(*b*)

Three years after the issue of the 'Fabrica' at Basel there appeared from the printing press at Venice a remarkable book, 'De Contagione' by Fracastorius, poet and physician, of Verona. He was born in that city in 1483 and was sent to Padua for his medical education. After the Venetian War of 1509 he settled as a medical practitioner at Verona and cultivated the love of science, literature, and philosophy he had acquired at Padua. He lived the greater part of the year on the Caphian Hills overlooking Lago di Garda, and here, at the age of 47, he brooded over the severity of the times and the cruelty and injustice of which he had been the witness in his native city, the aftermath of the wars between Francis I and Charles V, and between the imperial and republican factions of Verona. He has left us a stanza of his sombre thoughts:

> 'To what estate, O wretched Italy,
> Has civil strife reduc'd and moulder'd thee!
> Where now are all thy ancient glories hurl'd?
> Where is thy boasted Empire of the world?
> What nook in thee from barbarous Rage is freed
> And has not seen thy captive children bleed?'

But Fracastorius had a more constructive message to leave behind than this sad note. For here in his country villa he wrote the two medical books which brought him fame. The first was a poem, 'Morbus Gallicus', printed at Verona in 1530, the second was 'De Contagione' in 1546. In his medical practice Fracastorius had seen many cases of syphilis, plague, epidemic

typhus, and consumption, and his book is a record of his views as to the contagion of these diseases by seeds, or *semina*, which could, he believed, be generated spontaneously. He described three separate modes of infection, (*a*) by personal contact, (*b*) by intermediate agents, fomites, and (*c*) by aerial convection. He likens the first form to putrefaction passing from one grape or pear to another (as he had observed it in his garden), the *seminaria contagionum* being carried from one to another. The second mode is, he says, the same in principle, though the seeds, or virus, may remain intact and active for long periods. Infection conveyed by air he finds more subtle and penetrating, and it takes many different forms, some attacking animals and others man ; some the old and others the young, some one organ of the body, as the eye, others deeper organs, like the lungs. Fracastorius compared the process of contagion with fermentation of wine, two centuries before Pasteur, and he differentiated poisons from infections, showing that the former are not able to multiply or reproduce in the individual an agent capable of attacking another person. He introduced the term 'syphilis', and was one of the earliest to describe the disease ; he also described typhus fever and differentiated it from plague and other current pestilences ; and he argued that consumption was a contagious disease contracted by habitual residence with a consumptive, and that the infection may remain attached to clothing or house.

Mercurialis said that Fracastorius first opened men's eyes to the nature of contagion, and Dr. Charles Singer considers that he was the first writer to place 'the theory of infectious diseases on a firm and rational foundation'. His doctrine of spontaneous generation was disproved by Redi, and some of his views were dispelled by the invention of the microscope. His works were widely read and constituted the culmination of the medical conceptions of the Renaissance in regard

to infection. He gathered up the evidence of three centuries and stimulated future study in these matters by Falloppius at Padua, and the great Jerome Cardan of Pavia. His conceptions were generally accepted in England by Sydenham, put into operation by Richard Mead and Sir John Pringle in the eighteenth century, and scientifically proved during the nineteenth by Pasteur, Koch, and their disciples. Fracastorius died 'mid Caphian Hills' in 1553, and monuments were erected to his memory at Padua. 'The age in which he lived' wrote his biographer 'saw nothing equal to his learning but his honesty.'

(*c*)

There is a small Tuscan town in the valley of the Paglio, near Orvieto, named Aquapendente, and there in 1537 was born in humble circumstances Hieronymus Fabricius. Though his parents were poor they contrived to send their boy to Padua to study medicine under Falloppius. His progress was so rapid that in eight or nine years he was called to the famous chair of Vesalius, but, though the latter was professor for only five years, Fabricius of Aquapendente reigned for upwards of forty, receiving from the Venetian republic the supreme honour of the gold chain of the Order of St. Mark. It was for him they built the new anatomy theatre to celebrate thirty years' service, and in that theatre he taught Harvey.

Fabricius was a distinguished surgeon and scholar as well as anatomist. Above all he was a naturalist and taught the comparative structure of all animals. He wrote a book, 'De Formatione ovi', in which he described the development of the chick in the egg, and in his 'De Respiratione', on which he was working when Harvey came to Padua, he sets out his knowledge of the mechanism of breathing and of locomotion. On

the subject of the circulation he was a Galenist, though he added new knowledge as to the form, position, and distribution of the valves of the veins, which he described as 'little doors'. His book 'De Venarum ostiolis' was published in 1574. He believed that these valves delayed the flow of blood—which Galen-like he assumed was 'crude' blood travelling from the heart to the tissues—so that the limbs should not become congested with too great a flow of blood. Fabricius also wrote on the eye and ear, the structure and functions of the skin, the larynx and speech. He was an enthusiastic teacher and investigator, with generous sympathies and a keen sense of the responsibilities of his position, an all-round workman—anatomist, physiologist, surgeon, embryologist, historian. He exerted influence on generations of students and thus extended the reputation of Padua.

It was from this man that Harvey learned comparative anatomy, physiology, and embryology, and from him too he also learned to be a medical humanist. But the venerable old man was a Galenist and the dead hand of the Pergamite lay heavy upon him. 'So strong was the hold upon his mind of conceptions coming down from the past' said Sir Michael Foster 'that Fabricius's eyes were blinded to the facts staring him in the face, and his ears were deaf to voices crying out new views.' He was 63 when Harvey went to sit at his feet; he was followed in the chair by his faithful servant Casserius, and in 1616 by Spigelius, who both carried on his work. But the true succession passed to Harvey.

What exactly was the discovery which Harvey made? Let us consider it in the briefest possible form. Galen and Vesalius had both taught that the blood current acquired nutritive properties in the liver, that some of it when in the heart passed through the wall from the right to the left ventricle, and that air became mixed with the blood in the left ventricle. In 1553 Michael Servetus declared that no blood passed through the

interventricular septum, and that the blood was aerated by its passage through the lung and not the heart. Twenty years later Cisalpinus of Pisa had grasped the principle that the heart received blood from the veins and propelled it through the arterial system. Lastly, Fabricius of Padua had described the structure and position of the valves of the veins, though he had not understood their purpose. Thus matters stood when Harvey came to Padua. He listened to Fabricius, he then studied the matter for himself in man and animals, he considered the structure of the circulatory system and its purpose, and he 'weighed' (to use his own term) the physical factors affecting it. And briefly this is what he found. He first learned the nature and purpose of the heart beat, that the heart undergoes a contraction and a constriction, and forces all its contained blood into the arteries, the right ventricle into the pulmonary artery to the lungs and the left into the great artery (aorta) to the body, and no blood passes through the intervening wall. Secondly, he found that the blood coursing through the body was passing *from* the heart in the arteries and 'climbing back' to the heart in the veins by the support of their valves, 'a motion, as it were, in a circle'. 'The blood in the animal body' he wrote 'is impelled in a circle, and is in a state of ceaseless motion; that this is the act or function which the heart performs by means of its pulse; and that it is the sole and only end of the motion and contraction of the heart.' Thirdly, he saw that though the blood undergoes changes in the lung—the lesser circulation, and in the body tissues—the great circulation, it is one and the same blood. 'Sense and reason alike assure us that the blood contained in the left ventricle is not of a different nature from that in the right. . . . It is the same blood in the arteries that is found in the veins.' That is Harvey's threefold discovery.

Its effect was amazing. For his mode of procedure

vindicated for ever the experimental method; his finding placed the blood in the forefront of physical life, and gave it an altogether new meaning, chemical and physiological; lastly, the demonstration of the circulation gave a true conception to nutrition. Here was an end to 'spirits' and 'vapours', here was the operation of physical and physiological law. There was but one link missing, how the blood passed from the arteries to the veins. It was not until four years after Harvey's death that, with the aid of the microscope, Malpighi in 1661 observed the capillaries uniting, by their network, arteries and veins.

(*d*)

A fourth type of the Paduan pioneers who created its golden age of Medicine is Galileo Galilei. He was the son of a Florentine noble and was born at Pisa in 1564, the year in which Vesalius died and Shakespeare was born. He inherited from his father an aristocratic name, a love of music, art, and mathematics, an enquiring mind, and an impoverished patrimony. His father intended him for commerce, but the boy showed so much scholarly capacity at the convent school that at the age of 17 he was sent to the University of his native city to study Medicine. Nevertheless, he preferred Euclid and Archimedes to Hippocrates and Galen, and, turning to mathematics, became at the early age of 26 professor of that subject in the University.

Two episodes of his life at Pisa have come down to us. One day in the Duomo his attention was attracted by the great bronze lamp of the Cathedral, which, after lighting, the verger had left swinging to and fro on its chain. Galileo timed its oscillations by the only watch he possessed, namely, the beat of his own pulse—the rhythm of which he also measured by the pendulum—and observed that the time occupied by the swings was

the same though the range became smaller. Thus was suggested the law of the isochronism of the pendulum, which led to the invention of the astronomical clock. On another occasion he climbed the leaning campanile adjoining the baptistery, and before the assembled University he dropped a 100-pound shot and a one-pound shot from the top of the tower. Together they fell, together they struck the ground. ' The simultaneous clang of those two weights ' says Sir Oliver Lodge ' sounded the death knell of the old system of philosophy and heralded the birth of the new.' This contravention of the Aristotelians concerning the law of falling bodies contributed, with other like innovations, to Galileo's unpopularity at Pisa, and in 1592 he accepted the offer of the Senatori of Venice to be Professor of Mathematics at Padua.

Now began the splendid period of Galileo's life. He was 28, and, like Vesalius and the young Fabricius, he came into his kingdom in the first flush of manhood. His fame drew crowds of students, to whom he lectured in the *aula magna*, where his ' pulpit ', or rostrum, may still be seen, or, if the accommodation proved inadequate, they all turned out into the open air. He taught them the laws of motion and mechanics, the principles of the sundial, and ' the mutability of the celestial globe '. He perfected before them the telescope and invented a proportional compass, and with these instruments he demonstrated to the astonished students the Copernican helio-centric theory of the heavens, the new star of 1604, the mountains of the moon, the Milky Way, sun spots, and the satellites of Jupiter. The Senate, as well as the students, fell under his spell. The six-year tenure of the professorship ran a second lap, and then the twelve years became eighteen. It was a brilliant career, perhaps even in that great time the most dazzling in Europe ; it marked advance in the understanding of the laws of physics and the fundamental properties

of matter. For at Padua Galileo did much more than teach mathematics. He enlarged the field of the mind of man, he taught the balance between induction and deduction as a scientific method, he advanced the far-reaching truth that all physical forces within the human body and outside it are *measurable*. But alas! the fate of the prophet overtook him and in 1610 he left Padua never to return. Two years later he published his belief in the Copernican theory and came under the papal ban; in 1632 he underwent the persecution of the Inquisition; ten years afterwards, the blind, bereaved, old man passed beyond the power of his traducers. In spite of his recantation of his scientific faith, his work remained and brought forth a hundredfold. For it was sown in strength and raised in power. 'This is Galileo's main glory,' says Sir Oliver Lodge, 'that he first laid the foundation of mechanics on a firm and secure basis of experiment, reasoning, and observation. He first discovered the true Laws of Motion.'

The forerunners of Galileo had been Copernicus and Paracelsus, Telesio, Patrizzi, and Campanella; his contemporaries were Kepler and our own William Gilbert, of Colchester, the author of 'De Magnete', and the first President of the College of Physicians who was pre-eminent as physicist; and his immediate successors were Sanctorius of Padua, Descartes, Stensen, Borelli, and Malpighi. Yet once more the succession passed to an Englishman, Sir Isaac Newton. He it was who became Professor of Mathematics at Cambridge when 26 years old, and who took the learning of Descartes and Galileo, reformulated it and applied it to the differential calculus, to the law of gravitation, to a complete theory of astronomy, and to the beginnings of spectrum analysis. The 'Principia' was published in 1687.

It is important in the history of physiology to remember that for eighteen years the influence of Galileo permeated the first medical school of the age and left its ineffaceable

mark upon the growing science of all living things. Harvey himself must often have listened to the Professor of Mathematics, for the *aula magna* and the anatomical theatre adjoined each other, and Galileo's popular lectures were the talk of the University. We know to what physiological purposes Harvey applied the principles of mechanics. But even before that, and only a year after Galileo had left the University, Sanctorius, the Professor of Medicine at Padua, introduced physical measurement for the determination of chemical and physiological change. He constructed a chair suspended to a steelyard, and by this balance weighed himself before and after regulated meals, and thus measured the loss of weight due to, what he termed, insensible transpiration. 'If the food and drink in one day amount to eight pounds' he says 'the insensible transpiration will generally amount to about five pounds.' Quaint and imperfect as were his methods, he was a pioneer of the physical measurement of physiological processes.

Descartes, the philosopher and mathematician, though not associated with Padua, was a follower of Galileo, and added the method of reasoning to that of observation and experiment. It was part of his creed that man was a machine, an automaton (*machine de terre*) inhabited and governed by a rational soul (*âme raisonable*), and he was the first to explain physiological and mental functions in a mechanical manner. 'Other authors' said Stensen 'describe man; Descartes puts before us merely a machine.' From the medical standpoint two of the greatest disciples of Galileo were Borelli of Pisa and Malpighi of Bologna. Borelli was born at Naples and was two years old when Galileo left Padua, but in 1656 he followed him in the chair of mathematics at Pisa. He devoted himself to the mechanics of physiology, muscular movement, heart beat, and the resistance and elasticity of the arteries. He also investigated

the mechanics of respiration, secretion, and excretion. Borelli's friend Malpighi became Professor of Medicine at Bologna, Padua's great neighbour, and there with the aid of the newly invented microscope he worked as naturalist, embryologist, and pathologist. He discovered the capillaries and thus threw new light on the nutrition of the tissues, and as histologist he demonstrated the relation of structure to function and the response of structure to physical forces.

These men were the descendants of Galileo, and laid the foundations on which we build in that new world of physics, mathematics, and chemistry in their relation to Medicine which marks our own day and generation. But as I have said, the succession passed to England, and to the genius who knew, yet knew how little he knew. When an old man, full of honour and at the height of his fame, Sir Isaac Newton wrote : ' I know not what the world will think of my labours, but to myself it seems that I have been but as a child playing on the sea shore ; now finding some pebble rather more polished, and now some shell rather more agreeably variegated than another, while the immense ocean of truth extended itself unexplored before me.'

V

Such were four of the leaders and teachers of the School of Padua in the century which began on New Year's Day, 1538—an anatomist, a practitioner, a professor, and a physicist. Their influence spread through Europe, and Padua, in spite of conservative and reactionary elements, gave many sons to the advancement of learning and the science and art of Medicine. Its contribution was supreme in three respects.

First and foremost, Padua called men's minds back to Nature. Not Galen or other authority, not the text

of a book, not consistency with tradition, but the study of the human body was the issue that was joined—in the splendid words of Vesalius 'the study of that true Bible, as we account it, of the human body and of the nature of man'. This was the source of new truth in 1538, and it is the source to-day. 'It was in Padua' wrote Sir Clifford Allbutt 'that Medicine, long degraded or disguised, was to prove her lineage as the mother of natural science and the truth of the saying of Hippocrates that to know the nature of man one must know the nature of all things.' This return to Nature was not merely an elegant fancy or philosophic idea, it was a way of thought and of life. Nature was to be observed, and not only interpreted, as the *fons et origo* of truth; but more than that, she was to be interrogated, cross-examined, tested. The Paduan School made experiments and controlled experiments, as Aristotle had done before them; but they did more, for, following in the footsteps of Roger Bacon, they applied the experimental *method* to all things. It has been well said that 'by the ordering of experiment after a definite plan discovery is to be guided, doctrine tested, error dissipated, and the succession of natural phenomena ascertained'. This was what Galileo and Harvey did. By design they verified the fundamental premises. They taught the world mighty truths, but, better than that, the truths were natural and the offspring of their own experience. Their teaching was founded, as all consummate teaching must be, on their own research, their own first-hand knowledge of truth at the source. It is the supreme order, be the endeavour what it may.

Then in the second place, though to construct a true method is a larger gift to mankind than to discover items of knowledge, the Paduan School rendered inestimable service in extending the boundaries of learning. Vesalius revealed morphology as the bed-rock of systematic medicine; Fracastorius was the first of the

moderns in the realm of infection and epidemiology; Fabricius was one of the greatest of the early exponents of the elements of physiology and embryology; and Galileo opened the august chapter of the laws of mechanics and physics. In the main, therefore, Padua is associated with the basic elements of physics, anatomy, and physiology—in a word, with the essentials of the mechanics, structure, and function of the body. The superstructure was to be built by other men. What is significant, though not surprising, is that these Paduan pioneers inspired, as we have seen, a long succession of descendants and disciples whose intellectual germ plasm has continued to reproduce its kind in many nations down to our own day. Their work was of the nature of fruit; it grew from seed and it had within it the seed of more fruit. That is their enduring fame. We may be proud that among them was an Englishman, the immortal William Harvey, whose demonstration of the circulation of the blood and whose method of proof opened a new chapter in Medicine. 'I profess both to learn and to teach anatomy' he wrote 'not from books but from dissections; not from the position of the philosophers but from the fabric of Nature. I avow myself the partisan of truth alone.'

Lastly, there is a third characteristic of the progress of Medicine at Padua in its wonderful century, and it is this, there was co-operation and integration of the one into the many and the many into the one. The forerunners handed the glowing torch to these men of Padua—Vesalius, Fracastor, Galileo, and Harvey—who carried it forward with enthusiasm, devotion, and courage, and handed it on aflame to their followers—that was co-operation. But they did more. Biology was made by them to subserve anatomy, the anatomy was laid as the foundation of physiology, the physiology was illuminated and explained by physics, and the whole was applied to the healing art—that was integration.

There was correlation and interdependence and integration; there was a fresh and large understanding of the unity of Nature. These men lit a candle in Europe, the lamp of truth, and they used it to push out farther into the darkness which surrounded them, seeking the many in the one. They kept their lamp well trimmed and burning, but always, though sometimes unconsciously, for the single-minded Search. Coming out of a great time, they saw man's conquest of Nature and his partnership with the eternal wisdom. And in seeing this vision and following the gleam, they made their day the Dawn.

Was Browning thinking of such men in the last words of 'Paracelsus', in the hospital of St. Sebastian in 1541?

> 'If I stoop
> Into a dark tremendous sea of cloud,
> It is but for a time; I press God's lamp
> Close to my breast—its splendour, soon or late,
> Will pierce the gloom: I shall emerge one day.'

. . . .

Some of these were my musings that spring morning in Padua. But the evening came, and its long shadows fell across the plains of Lombardy and enshrouded the Euganean Hills; the workers came in from the fields and vineyards, the city toilers rested from their labours, the great bell of the Cathedral sounded the Ave Maria at sunset; and walking away in the twilight through those quiet and forsaken streets of the Middle Ages, familiar three centuries ago to Fabricius and Galileo and Harvey, I listened to 'the deep sad murmur of voices long dead'.

THOMAS SYDENHAM, REFORMER OF ENGLISH MEDICINE

¶ *Written in* 1924 *for the Tercentenary of the Birth of Thomas Sydenham, M.D.* (1624–1924).

THOMAS SYDENHAM, REFORMER OF ENGLISH MEDICINE

For God of His gifts pour'd on him a full measure,
And gave him to know Nature and the ways of men.

SHAKESPEARE ODE—*Robert Bridges, M.D.*,
Poet Laureate, 1916.

IN the soft and pleasant country which lies to the west of Dorchester, and which has been made familiar to us in the Wessex novels of Thomas Hardy, there stands a grey old manor-house with gables, porch, and mullioned windows. It is solidly built of stone and flint, now thickly covered with ivy, and is surrounded by a high-walled garden and a large orchard. Jacobean panelling within tells of former glory. This is the manor of Wynford Eagle, a haunt of ancient peace far from the madding crowd, where

'daisies pied and violets blue,
And lady-smocks all silver white,
And cuckoo-buds of yellow hue,
Do paint the meadows with delight.'[1]

Through whatever changing vicissitudes this old house passed, it was probably here in the late summer of 1624 that Thomas Sydenham was born, just three hundred years ago. His father came of distinguished stock which had inhabited the district from early in the fifteenth century. He was a strong Puritan, and even as an elderly man fought in the Parliamentary army in the Civil War. He married Mary, the daughter of Sir John Jeffrey, of Catherston, and they had ten children, three of whom were daughters. Thomas, the seventh child, was baptized in the adjoining church on September 10th, 1624. We

[1] 'Love's Labour's Lost', V. ii.

know nothing of his boyhood, spent probably in Dorsetshire, where also no doubt he received an education preparatory to his admission, in May, 1642, to Magdalen Hall, now Hertford College, Oxford. This was the popular Puritan college of its day, and its principal, Dr. Wilkinson, was one of the chief leaders of the Puritans in the University. Young Sydenham's career was, however, cut short by the conflict between King and Parliament. The University and city of Oxford being in favour of the King, Sydenham returned home, and with two of his brothers enlisted in the Parliamentary forces, the district being by repute a 'great seat of disaffection'. At Poole, Wareham, Weymouth, and elsewhere, Sydenham shared in the strife, losing by death his brother Francis and even his mother, who was killed in a fray, accidentally or otherwise. By 1646 the first stage of the Civil War was ended, and Sydenham went back to Oxford after four years' absence. Writing long afterwards, he tells us in his own words of his return to his studies.

'It is now thirty years since I had the good fortune to fall in with the learned and ingenuous Master Thomas Coxe, Doctor, who was then attending my brother during a sickness; and who from that time until the present has followed his profession with success. I myself was on my way to London, with the intention of going thence to Oxford; the breaking out of war having kept me away for some years. With his well-known kindness and condescension, Dr. Coxe asked me what pursuit I was prepared to make my profession; since I was now returning to my studies, which had been interrupted, and was also arrived at years of discretion. Upon this point my mind was unfixed, whilst I had not so much as dreamed of Medicine. Stimulated, however, by the recommendation and encouragement of so high an authority, I prepared myself seriously for that pursuit.

After a few years spent in the arena of the University, I returned to London for the practice of Medicine.'[1]

He entered as a fellow-commoner at Wadham, ' though I had bin of Magdalen Hall before', and was created Bachelor of Medicine in April, 1648, at the beginning rather than the end of his course of study, by the patronage of the Chancellor, the Earl of Pembroke. In October of the same year patronage also obtained for him the appointment of Fellow of All Souls, and subsequently Bursar, probably in place of an expelled Royalist; and there he remained until 1655.

Sydenham at Oxford

With the exception of a few months in 1651–1652, employed in a brief second period of military service under Cromwell, Sydenham was therefore at Oxford from 1647 to 1655, a period of not less than eight years. No doubt as Fellow and Bursar he had collegiate duties to perform, but a substantial part of this long period was available for the study of Medicine, for listening to the plethora of sermons characteristic of the period, and for ' disputations'. There was opportunity for renaissance at Oxford as a result of Puritan rule within the University, which yielded, even as Clarendon allows, ' a harvest of extraordinary good and sound learning'. Sydenham drank at this source. Probably his actual medical studies followed the traditional course of the sixteenth century, which had been reformed by Linacre, fresh from Padua and deeply imbued with the Greek spirit. Linacre was a Galenist, a grammarian, and a medical humanist, and he founded lectureships at Merton College, Oxford, for teaching the doctrines of Hippocrates and Galen. His own translations of Galen

[1] ' The Works of Thomas Sydenham, M.D.' (Latham's translation of Greenhill's edition), 1848, Vol. I., p. 3.

were declared by Erasmus to be more valuable than the original. When Sydenham was at All Souls the Regius Professor of Medicine was Sir Thomas Clayton, Warden of Merton—the college which for two centuries enjoyed the reputation of being the most distinguished medical college in England—and from him Sydenham may have acquired his love of Hippocrates. Clayton also taught anatomy, his substitute in this subject being Dr. William Petty, who, though an economist rather than a physician, had studied anatomy at Leyden. There was, of course, no clinical instruction at Oxford at that time, and the only other medical subject was botany, which was studied in the Physic Garden established near Magdalen Bridge in 1632.

More valuable than any direct medical training which Sydenham received at Oxford were the friendships which sprang from his long sojourn at the University. In addition to Sir Thomas Clayton and Dr William Petty, there was Cromwell's physician, Dr. Jonathan Goddard, whom he had made Warden of Merton in 1651 (in place of the great Dr. Harvey, appointed by Charles I); there were Christopher Wren and Thomas Millington (afterwards President of the College of Physicians), who were colleagues and friends of Sydenham as Fellows of All Souls; the famous Robert Boyle, philosopher, came up to Oxford in Sydenham's last year; there was the rising young physicist, Hooke; Dr. Willis was already in practice in a house opposite Merton, and subsequently settled in London as a near neighbour; and his friend Richard Lower worked with him both in Oxford and London. During the last two years of Sydenham's residence there came as a student to Christ Church, John Locke. We do not know when Sydenham and he first met, but they became close medical friends, and influenced each other profoundly, a partnership in thought and work. Locke's 'Essay on the Human Understanding' was published in 1690,

after Sydenham's death, but its preparation dated from 1670, when five or six friends meeting in Locke's chambers for discussions on philosophy found it necessary first to examine the nature of man's mind. Dr. John Brown believed that Sydenham was one of them; be that as it may, in medicine and in philosophy there was identity of purpose between Locke and himself. Mutually they agreed that knowledge is derived from experience, gained by observation of the functions of the senses and by reflection; that by association of ideas truth becomes judgment; and that, in Locke's words, 'the taking away of God, though but even in thought, dissolves all'.[1] It was whilst they discussed these themes that Milton wrote, in 1671:

> 'Just are the ways of God,
> And justifiable to men;
> Unless there be who think not God at all.
> If any be, they walk obscure;
> For of such doctrine never was there school,
> But the heart of a fool,
> And no man therein doctor but himself.'[2]

We do not know the degree or character of the influence which Sydenham's Oxford friends exerted upon him. He speaks warmly of such influence in the case of Locke, Dr. Goddard, Sir T. Millington, and Boyle, and of several of his friends of later years. But there were other influences at work in his responsive mind. Ever after Oxford he was the loyal and obedient disciple of Hippocrates of Cos, 'the divine old man' as he calls him; he described Cicero as 'the author that I most admire, as the great teacher both in thought and language, the first genius of his own and perhaps of all ages', and he translated him into English, retranslating into Latin; he

[1] Fowler's 'Life of Locke', chaps. viii. and ix.
[2] 'Samson Agonistes', 1671.

learned much from Bacon's 'Advancement of Learning' and the 'Novum Organum', both relatively new books much discussed at Oxford, and some of the principles of which Sydenham made his own. Above all, though he walked alone, he belonged to a generation of the strongest, most masterly, and most powerful intellects that England has ever known. An age which contains Shakespeare, Bacon, Milton, and Dryden—and Galileo, Kepler, Descartes, Boyle, and Newton—and three pre-eminent medical pioneers like William Gilbert of Colchester, William Harvey of Folkestone, and John Locke of Wrington, cannot be otherwise than one of the supreme formative periods of human endeavour. And Oxford was the home of the classics and the new Greek learning. Colet, Erasmus, More, and Linacre had fertilized the seed of the Renaissance, and had demanded freedom of enquiry and thought, tolerance, and a wider and more liberal education. Sydenham did not find in Oxford what he sought—complete medical instruction—but he found the bright morning of renaissance in his own mind.

Settles in London

In 1655 Sydenham was married to Mary Gee at Wynford Eagle, and in that year, or in 1656, he resigned his Oxford fellowship and started medical practice in Westminster. First he lived in King Street, and ten years later moved to Pell Mell. In these two contiguous localities he lived out his uncertain life, near the hub of things but outside the confines of London. For in the middle of the seventeenth century Westminster was almost a separate town from the City, under the sway of the Abbot rather than the Lord Mayor. There was the stately Abbey, Westminster Hall, and Whitehall Palace, and near these were gathered the homes of the official classes hard by the hovels of the poor and of seekers of sanctuary. Round about lay the swamps and

marshes of the unconfined Thames. The Palace consisted of a vast congeries of buildings and pleasure grounds, covering almost the whole of what we call Whitehall, through which passed the public highway, King Street, between the glorious Holbein Gate (which stood until 1759) and the High Gate built by Richard II. It was a narrow street, with a network of smaller streets and courts on either side at its southern end. Here Sydenham lived. The houses rose three or four storeys, gabled all, with projecting fronts, the timbers painted or gilt, some of them bearing escutcheons or brightly blazoned arms, or carven beams or signs. There were taverns, and much coming and going, wagons, pack-horses, pedestrians, and the motley crowd which frequent camps and Courts. Down it passed the pageantry of funerals, coronations, and State shows. Lord Howard of Effingham set out from King Street to fight the Spanish Armada, Charles came down it to his trial in Westminster Hall, Cromwell lived in it, and Colonel Sydenham and many of the Parliamentary leaders and soldiers. Here in 1599 died Edmund Spenser, author of 'Faerie Queene'. Milton had left Whitehall when Sydenham arrived, and was living near by in a house overlooking the Park.

We know but little of the medical practice of Sydenham in those early years. It must have been broken and uncertain, for his clinical equipment had been small and his political inclinations were absorbing. He became a candidate for Parliament, but happily was unsuccessful. He was appointed to a minor post in the Exchequer, now obsolete, and within three or four years of settling in King Street he went to Montpellier to improve his medical knowledge. Here it was, probably, that as a pupil of Barbeyrac he obtained his first insight of clinical work. At that time the medical school at Montpellier was attracting as many Englishmen as Padua, and had

been commended to him at Oxford. Barbeyrac, a French Protestant, was one of the most popular physicians in Montpellier, and, though not a recognized professor in the University, conducted extra-mural classes in connection with his own private practice, a dozen students accompanying him on his rounds. His method of instruction—simple, direct, unorthodox—was founded on careful clinical examination of each patient, using few but efficacious remedies. In after years Locke, who knew Barbeyrac well, described Sydenham and Barbeyrac as similar in method and outlook, and it has been assumed that this was the source of Sydenham's clinical aptitude. Soon after Sydenham returned home he obtained the licence of the Royal College of Physicians authorizing him to practise in London. He never became a Fellow of the College, partly because he did not take his doctor's degree at Cambridge until later on (1676), and was thus ineligible, and partly because he then thought well not to apply for it.

Medical practice in England in the seventeenth century was deeply marked by two influences. The equipment of the medical man was classical, and Latin was the language of professional composition and communication. He was drilled in the traditions of Aristotle, the aphorisms of Hippocrates, the doctrines of Galen, parts of the Canon of Avicenna, for Medicine was taught as a branch of polite learning and philosophy. To these there came to be added botany, furbished up by herbals. In plant lore Shakespeare's England was rich with heritage of Anglo-Saxon origin. Turner, the father of English botany, and doctor of physic of Ferrara, wrote the 'New Herball' in 1568, and Gerarde's 'Herball' came in 1597 and was held in high repute for generations. A hundred years before, Vesalius had re-inspired anatomy, and biology had been enlightened by Gesner, but neither subject had become a vital part of the curriculum.

Physiology had recently found its seer in Harvey, whose demonstration of the circulation of the blood had not begun to affect practice. The place of physics had been shown by Gilbert, and Paracelsus and Van Helmont had staked out claims for chemistry. The period itself, indeed, was a ferment of intense individual scientific endeavour in many fields, which was to have a rich and abundant harvest. But it was not yet. The College of Physicians was the conservative guardian of medical learning, which the Universities included as part only of a literary education. Of systematic clinical observation and instruction there was none. In this situation progress in practical medicine was dependent upon innovators, of whom Sydenham was chief.

The second influence was the turmoil of the Civil War. Following it came disregard of tradition, the ascendancy of heterodoxy in opinion and practice, and the loosening of the bonds of discipline. The result was an enormous extension of quackery, pseudo-scientific exposition, and even astrology; there was increase in the crowd of herbalists, water-casters, hawkers of amulets and charms at country fairs, charlatans, and impostors. When Sydenham was at Oxford the author's final edition of the 'Anatomy of Melancholy' was being read. It is the book which brought Johnson from his bed two hours before time. 'There are in every village' wrote Burton 'so many mountebanks, empiricists, quack-salvers, Paracelsians, wizards, alchemists, poor vicars, cast apothecaries, barbers, and good-wives, professing great skill, that I make great doubt how they shall be maintained, or who shall be their patients.'[1] After the male quacks came a monstrous regiment of women—midwives, nurses, 'every house its old woman'; and besides the competition of these spurious professionals the registered physician had to compete with barber-surgeons and apothecaries; 'and all our ladies and

[1] 'The Anatomy of Melancholy', by Robert Burton, Vol. I.

gentlemen ' wrote Dr. Wharton ' keeps and stores up receipt books and closetts of medicines fitted for most occasions '. It was Lord Herbert of Cherbury who claimed that ' it will become a gentleman to have some knowledge in Medicine, . . . how to make medicine, himself, and afterwards prepare them with his own hands '.[1]

It was in the midst of this transition from tradition to science, and amid this weltering chaos and scramble, that we see emerging the strong figures of English Medicine — Harvey, Glisson, Willis, Morton, and Sydenham ; and ' the prince of practical physicians ' was Sydenham.

Sydenham as Physician

While Harvey was engrossed in experimental science Sydenham set himself to be a practitioner of the art of Medicine, ' the greatest of all gifts appertaining to human life,' he calls it, ' preferable to all others in the same proportion as life itself is the greatest of enjoyments '. Ploughing his lonely furrow, discarding tradition, ignoring the prevalent current fashion of speculation, despising charlatanism, he bends himself solemnly to his great task. And first he asks himself, What is the duty of a physician ? and this is his answer :

' The function of a physician is the industrious investigation of the history of diseases, and of the effect of remedies, as shown by the only true teacher—experience, attention being directed to that method only which right reason, based upon common sense and *not* upon speculation, dictates.'

Then he adds one of his penetrating comments—

' That practice, and that alone, will do good which

[1] ' Shakespeare's England ', Vol. I., p. 511. ' Diary of John Evelyn ', 1685, February 4th (King Charles's knowledge of empirical medicines).

elicits the indications of cure out of the phenomena of the disease itself. This made Hippocrates divine. . . . True practice consists in the observations of Nature; these are finer than any speculations. Hence the medicine of Nature is more refined than the medicine of philosophy. . . . The chief weakness of medicine is not our ignorance as to the ways and means by which certain indications may be satisfied, but our ignorance of the particular indications that thus want satisfying.'[1]

Like Vesalius a century before, like Harvey one generation earlier than his own, Sydenham not only perceived the thing which had to be done, but he found the principles of approach. Most of the men of his time lacked not only true vision, but they failed to prescribe reasoned ways and means. He gave us both; and he found them both, as did Vesalius and Harvey, by going back to Nature. 'I assist Nature' he says 'as Hippocrates bids me. . . . We often attend too little to the intentions of Nature in the cure of disease, and set up on insufficient grounds some different method of cure'; and again, 'it is by joining hands with Nature and by aiming properly at the same mark that we are enabled to destroy disease'; and once more, 'I have been no man's follower, but Nature's only'. In this last brave word our physician must for once have overlooked Hippocrates. For Sydenham was a Coan.

So he set to work to define an orderly and systematic scheme of clinical study, to consist of three parts: (1) an exact description of the disease before him; (2) a method of remedy; and (3) where he could discover them, the use of specific forms of treatment. This is what he says:

'I conceive that the advancement of medicine lies in the following conditions. There must in the first place

[1] 'Works', Vol II., pp. 12, 22, 172.

be a *history of the disease*, in other words a description that shall be at once graphic and natural. In the second place there must be a *praxis or methodus medendi*, and this must be regular and exact, fixed, definite, and consummate, by which I mean a line of practice which has been based and built upon a sufficient number of experiments and so proved competent to cure this or that disease. In addition to the two aforesaid desiderata in medical science a third may be enumerated, namely, *the discovery of specific remedies*."

This is the core and substance of the Preface to his famous book, 'Observationes Medicae', first issued in 1666 under the title of 'Methodus Curandi Febres', and subsequently re-issued in 1676 with the dedication to Boyle and the laudatory poem by Locke. With this as his conception Sydenham fares forth on his quest—heart and mind according well. 'In all cases' he says 'it behoves prudent and honest physicians to acknowledge and entreat the Divine Goodness, that from this they may look for wisdom and good fortune. They ought not to be satisfied with simply giving health to the sick, but they should strive to add greater certainty to the art they administer, and so direct their experiments that the Science of Medicine may also grow day by day more clear and efficient.' It was just half a century since Shakespeare, in one sure thought, had made Polixenes proclaim the supremacy of Nature—

> 'Yet Nature is made better by no mean
> But Nature makes that mean; so o'er that art,
> Which you say adds to Nature, is an art
> That Nature makes . . .
> this is an art
> Which does mend Nature, change it rather, but
> The art itself is Nature.'[2]

[1] 'Works', Vol. I., pp. 12–21. [2] 'Winter's Tale', IV. iii.

This apprehension of the scope and function of the medical practitioner not only furnished Sydenham with a life-purpose, but it gave to English Medicine an enduring foundation. It changed its whole orientation, and builded it upon a rock. New knowledge has enlarged its compass and orbit, but it has not changed its genius. On his return to London from Montpellier, Sydenham set to work to apply these principles. This he did in his private practice. He had, as far as we know, no hospital appointment or other means of gaining clinical experience or teaching his views. He set to work just where he was in King Street, and with the diseases which came his way. These happened to be the acute fevers so prevalent in England in the seventeenth century—agues, sweating sickness, plague, influenza, small-pox—but hysteria, gout, dropsy, and other conditions came within his field of observation; whatever disease it be, Sydenham pursued his plan. First, he sought the facts, 'the clear and natural phenomena of disease, these and these only', classified them, induced from them, and drafted his views of the natural history, as he calls it, of the condition. Signs and symptoms were recorded, and variations and seasons of occurrence noted. His contemporaries meanwhile explained disease according to some preconceived theory, chemical, Cartesian, or other, and directed their practice by it. They sought ultimate causes, he the immediate and proximate ones. Secondly, having obtained his facts, he attempted, though with less success, to differentiate one morbid process from another. He was without any science of pathology, which has been generally accounted as a disability, but which Cullen of Edinburgh commended. Though he examined the chest, he had no stethoscope; though he investigated the excretions of the body, he had few tests; and though he had regard to anatomy and chemistry, the value of which he expressly defended, he made little use of them in

practice. Nevertheless, he shared with Glisson and Willis the first introduction of clinical differential diagnosis. Lastly, we come to his mode of treatment. The phenomena of disease, he says, guide us to the indications of treatment—a proposition which remains true though the kinds of treatment have changed—and it was this fact which led Hippocrates to say that ' our natures are the physicians of our diseases '. Hence, according to Sydenham, Nature is to be aided ' by the fewest and simplest forms of medicine, and at times she is independent even of these '.

All this was strange and unwelcome doctrine to the practitioners of the day, who were accustomed to dose or bleed their patients with vigour. Even Sydenham did. Here is an ointment he prescribed for a scrofulous baby; it contains leaves of twenty-one plants, and is to be rubbed on the poor child's body, night and morning, for thirty or forty days. Here is a medicine for gout, to be taken twice daily, and it consists of thirty-one herbs mixed with honey and Canary wine. ' Each ingredient takes part in the cure,' he apprehends. ' The more numerous the simples the more potent the medicine.' He was an advocate of Canary wine for small-pox, gout, and dropsy, and prescribed it for himself. Whilst he practised blood-letting, and was a great user of opium, 'a divine gift ' (' Laudanum Sydenhami ' may still be seen inscribed on old French pharmacy jars), and of cinchona bark (quinine), his medical treatment was usually of the simplest. For small-pox he advised the cooling method. ' I had no fire in my room,' writes one of his patients, ' my windows were constantly open, my bed-clothes were ordered to be laid no higher than my waist. He made me take twelve bottles of small beer every twenty-four hours.' An old gentleman suffering from hysteria, and subjected to blood-letting, is bidden to consume a roast fowl and some Canary wine. Horse exercise is often recommended.

'Of all the remedies that I know, nothing so cherishes and strengthens the blood and spirits as riding on horseback long distances every day'; and he advises it especially in hypochondria, early gout, and biliousness. He is full of common sense: 'Give your patient a holiday from his bed'; or 'Nothing undermines the forces of Nature like late hours'; or again, as Cardan and Burton had said, let the patient eat what he likes if it agrees with him, but in moderation. So there it is; he is for exercise and the open air, for simple dietary, purging, rest, and sleep. Shakespeare was before him, and fully recognized the medicinal value of

> 'Sleep that knits up the ravell'd sleave of care,
> The death of each day's life, sore labour's bath,
> Balm of hurt minds, great Nature's second course,
> Chief nourisher in life's feast.'[1]

Sydenham's simple plan of 'what is useful is good' was well sustained by his own innate simplicity and straightforwardness. He had humour and honesty and benevolence, great virtues in a practitioner; and he won and retained the confidence of his patients. His popularity was slow in growth because of his detachment from his contemporaries, but in the end his triumph was unquestioned.

It was indisputable in spite of the fact that he disregarded the new knowledge so rapidly accumulating around him. He makes no mention of Harvey's discovery of the circulation of the blood, which had been announced exactly fifty years before Sydenham wrote his first book. Following Harvey came a stream of subsidiary investigations, on the inter-relationship between blood and lymph associated with the names of Aselli in 1627 and Pecquet in 1651; on the operation

[1] 'Macbeth', II. ii. 38.

of the new physics and their effect upon muscular movement by Descartes and Borelli from 1637 onwards; on the capillary circulation by the great Malpighi; on the secretions of the pancreas, the salivary glands, and the liver by Wirsung, Wharton, and Glisson from 1643 to 1656; on transfusion, dropsy, and diabetes by Lower and Willis—but it seems all to have been an unopened book to Sydenham. It may be said this new knowledge had little to do with fevers, but he estimated the incidence of fevers yet ignored the Bills of Mortality of John Graunt. He was a day-by-day practising physician, yet unaffected by the contemporary work of his fellow practitioners, Sir Theodore Mayerne and Glisson and Willis. It seems very strange. Perhaps it was temperamental, perhaps a studied effort to exclude the influence of others upon his own mind. He seems to have contracted that peculiar characteristic of the seventeenth century of doing good work in a water-tight compartment. It was an age of the greatest intellectuals England had ever known, but often they laboured each in his own vineyard and under his own fig-tree. 'Life was lived at too high a pressure' wrote Sidney Lee 'to maintain outward show of unity of purpose.' Of course, the means of intercommunication were slight, precarious, and uncertain compared with those of our own day; and the value and meaning of not a few of the discoveries of the time, including that of Harvey, could not be gauged at their true worth. Modern knowledge is more integrated; modern practice is more co-operative. The practitioner is now furnished with facilities and implements of precision undreamed of in Sydenham's day—the stethoscope, microscope, thermometer, ophthalmoscope, and X-ray. His equipment in physiology, pathology, and bacteriology has given him a wholly new understanding of the human body in health and disease. Yet the principles of direct clinical study, of the non-reliance on tradition and the return

to Nature, of the scientific method of observation and induction, laid down by Sydenham as the foundation of sound medical practice, will endure for ever.

Sydenham's Little Books

Sydenham had been in practice only half a dozen years when he produced, in the forty-second year of his age, his first book. It was a small octavo volume of 156 pages on continued and intermittent fevers and small-pox. It was dedicated to the Hon. Robert Boyle, F.R.S., who had suggested its publication, and it records the personal clinical observations of its author. It was well received in scientific circles in England and abroad. A second edition became necessary in two years' time, and to this Sydenham added a chapter on plague and a laudatory Latin poem by John Locke. In 1676 a third edition came out, entitled 'Observationes Medicae', which became his most famous work, and described the fevers of London from 1661–1675. It was dedicated to Dr. John Mapletoft, who was Professor of Medicine at Gresham College and probably translated the book into Latin. The several prefaces and letters of dedication of the editions of this book contain autobiographical notes of Sydenham's, his conceptions of the ideals and duties of medical practice, and his *apologia pro vita sua*. It is from this book, and the other precious little old-world volumes which followed it, that we glean our fragmentary knowledge of the life and thoughts of the great physician. From their pages alone can we now learn who were his friends, who his heroes, and what manner of men; what were his aims and hopes; and what the deep springs of his purpose. Here are some dull details about the use of bark, and then out flash these words: 'There is but one sort of true wisdom, to take a true measure of one's self and not to throw dust in one's own eyes'. It is

Greek in inspiration, and it homes back two thousand years. 'I am convinced' he says 'that Nature moves in a reasoned and orderly manner.' Is there much more to be said than this? The man who in the seventeenth century was convinced that the universe is *rational* had travelled a long way in mind and heart, and his anchorage was sure.

The prevalent fevers of the time were studied by his contemporaries, but Sydenham alone re-interpreted the Hippocratic conception of epidemics, and in such a way as to lay the foundations of modern epidemiology. Here, as in his general practice, he sought to return to Nature, observing and collecting facts upon which to build principles. Let us consider in simple terms what he says in this little book. (*a*) Certain fevers, he saw, had an epidemic character, which bred true; and the features of such outbreaks followed a type year after year; they were, in fact, 'regular and uniform, with the same phenomena and a general conformity of symptoms'. Then he saw also (*b*) that there were *variations*, 'Nature playing tricks'—the same disease, as he believed, manifesting itself with various dissimilar aspects as to origin, formation, decline, 'like a monarch with a bodyguard of foreigners'. Well, then his next observation was (*c*) that both typical and atypical fevers prevailed at certain times, dependent, he thought, upon meteorological or atmospheric conditions, or other external influences. He began to feel out after the idea of *contagion*, though not very surely. As he disregarded the progress of physiology, so, in fevers, he seemed oblivious of the advance which had taken place in the conception of contagion and infection. Jerome Fracastor of Verona had originated it a century before, and Cardan and Falloppius of Padua had developed it in the sixteenth century. In Sydenham's own time, Kircher, a Jesuit Father, had promulgated the view that micro-organisms acted as vehicles of contagion, and Descartes had proved their mechanical

possibilities. But apparently much of this was outside Sydenham's knowledge, or perhaps he was sceptical as to its worth. However that may be, he saw (*d*) that when several fevers infested the same period one of them had an ascendency over the others. When the paramount complaint increased they declined, when it lost ground they increased. The disease or symptoms which predominated determined the 'epidemic constitution' of that season, and thus there were different epidemic constitutions in different periods, with a counterpart seasonal predisposition in the human constitution. Lastly, he saw (*e*) that some epidemic constitutions were secular in length, long-period, and others were short and seasonal. Here is his table for the years of this particular study of London fevers:

1. 1661–1664. Intermittent fevers predominated and continued fever.
2. 1665–1666. Plague predominant.
3. 1667–1669. Small-pox constitution.
4. 1669–1672. Dysentery and cholera, with continued fever and measles.
5. 1673–1676. Comatose fevers and influenza.
6. 1678–1680. Return of intermittent constitution.

Such are the five principal points in Sydenham's Doctrine of Epidemics. They accord with the epidemics of Hippocrates in the island of Thasos in the fifth century B.C., and Thucydides describes a plague constitution at Athens in 430. Yet Sydenham not only re-interpreted Hippocrates, but independently defined the purpose of fever (as Nature's way of expelling 'morbific humours' from the body); studied the actual signs and symptoms, the natural history, of the disease; attempted to differentiate the various fevers and allocate causes of their becoming epidemic; and showed that the decline of an epidemic constitution was followed by secondary and

variant maladies referable, as he believed, to a common cause. All the way through the book he discourses of the characteristics of each of his five groups and sprinkles his pages with medical advice and prescriptions. Much of his remedy is now obsolete, but this book won for him the title of the 'English Hippocrates', and it gave, once and for all, a peculiar and distinctive Coan quality to English Medicine.

Sydenham's other little books were dragged out of him by his friends. He received a letter from Dr. Robert Brady, the Master of Caius, the Regius Professor at Cambridge, a Royalist and physician to the king, asking him about the use of quinine and the treatment of rheumatism. Another letter came about the same time from Lambeth Palace, from Dr. Henry Paman, companion to Archbishop Sancroft and Public Orator at Cambridge, who wrote complaining of the ineffective treatment of venereal disease by 'quacks, barber-surgeons, and mountebanks', and he begged Sydenham to 'send something' on this subject. Sydenham replied to both these correspondents, whose very requests have brought them fame, and published his letters in 1680 under the title 'Epistolae Responsoriae'. We cannot now consider the contents of those two letters; but here out of the dark slough of venereal disease rises a white water-lily: 'If we reject all cases of affliction which the improvidence of human beings has brought upon themselves' he says 'there will be but little room left for the exercise of mutual love and charity. God alone punishes. We, as we best can, must relieve. Neither must we be too curious as to causes and motives, nor too vexatious in our censorship.' Could the ethics of a venereal disease clinic be stated better than this?

A year later he had a letter from Dr. Cole, of Worcester, an unknown correspondent, thirsty for more knowledge after reading Sydenham's 'golden book', as he calls it, on fevers. Subsequently Cole settled in London, a man

'learned without ostentation and polite without affectation'. Sydenham wrote him the 'Dissertatio Epistolaris' (1682) on small-pox and hysteria. It was this letter of about 2,500 words which contained the baby's herbal ointment and the roast chicken for the hypochondriac. But it contained also some of the enduring materials and precisions which made Sydenham a master builder. He harks back twenty years to his first principles—Nature and observation and experience—and he drives right home in a single sentence, 'only facts are the tests and touchstone of truth'. Another letter of similar length, and of higher medical value, on gout and dropsy, was addressed to Dr. Thomas Short, a Roman Catholic professional friend who, in stormy days, had defended Sydenham. He succeeded to Dr. Lower's consulting practice, which had formerly been in the hands of the fashionable Dr. Willis.[1] Sydenham was himself for thirty years the victim of gout, and evidently wrote this tract under physical disability and stress. The preface is a noble exordium from a man who believes his remaining days are few, and he reviews the past and looks into the future with the philosophic calm of a man whose confidence is fixed. The masterly description of gout given in this little book ('Tractatus de Podagra') of 1685 is, in some ways, the most suggestive and realistic picture of that disease to be found in all medical literature. Cullen copied it, and it has been the basis of the clinical delineation of gout ever since. Sydenham knew he had written something worthy, and on the title page he placed a favourite motto from Bacon: 'We have not to imagine, or to think out, *but to find out*, what Nature does or produces'. As Dr. Payne says, no words could more truly express Sydenham's own method.

In 1686 Sydenham brought out 'Schedula Monitoria',

[1] Dr. Short advised King Charles II to take quinine ('Diary of John Evelyn', November 29th, 1695).

the last medical work published in his lifetime, a supplement to his Medical Observations dealing with a 'new' fever, and recording some later thoughts on cholera, hysteria, and calculus. It was inscribed to one of his oldest and nearest friends, Dr. Goodall, the 'Stentor' of Garth's 'Dispensary', and subsequently President of the College, 'second to none in the art you practise, whose equal I have never met for thorough honesty and integrity'. Though Sydenham says this book concludes all he had to say, it was not the last from his hand, for in his later years he compiled a summary of his means of treatment for the use of his son. This tiny volume, 'Processus Integri', issued after his death, was sold in many thousands in various editions in England and abroad. It names *seriatim* sixty-one morbid conditions, with advice as to treatment and prescriptions. It became the guide and companion of English practitioners for more than a century, and gave Sydenham a unique place in his profession.

Sydenham the Man

The beautiful portrait of Sydenham which hangs in the College of Physicians, and which was painted by Mrs. Beale, the mother of one of his pupils, gives us the impression of a man of robust frame, manly and simple. He wore his hair long and parted in the middle, after the manner of the time, without a wig. In his prime his face was frank and massive, his eyes tender, kindly, and humorous, his lips full and strong, with the chin of a judge. The portrait gives his bearing as dignified, conciliatory, and judicial; there is an air of sadness about it, which is winsome rather than austere, steady and thoughtful rather than fretful. It must be remembered he was, even from his Oxford days, something of an invalid, and in later years often laid aside from his work for weeks at a time with what he calls 'continual maladies'.

Of his tranquil home life we know little, and even less of his wife and three children. Beside his family Sydenham had pupils living in his house, including Dover, Beale, and Hans Sloane (who became a distinguished naturalist, President of the Royal Society and the College of Physicians, and founder of the British Museum). The first ten years of his London practice were spent in the crowded King Street, and the last twenty in a house in Pell Mell, the position of which Dr. Payne says was near the foot of the Haymarket. The south side of Pell Mell had not been built, and the house looked out directly into the Mall and St. James's Park towards Westminster. When the plague came in 1665 Sydenham, like Milton and many others, removed in June to the country. ' The danger came to my own door ' he writes ' and I was persuaded by my friends to add myself to the increasing list of fugitives. I and my family retired a few miles from London.' From some points of view this absence was unfortunate, and it separated Sydenham, as he admits, from ' those physicians who, throughout all the stages of that scourging calamity, with danger all around them and with the thousand shapes of death before their eyes, had heart and soul to stand at their posts '. No doubt there were sufficient reasons for his flight. Death had recently taken his father and brother, his own health was precarious, his patients had left town. But if he had remained, medical literature might have been enriched by an adequate description of the plague.

In the ' Schedula ', written in 1686, Sydenham gives us an insight of his daily life and habit towards the end.

' On getting out of bed, I drink a dish or two of tea, and ride in my coach till noon ; when I return home, and refresh myself moderately (for moderation is the one thing to be always and most strictly observed) with some sort of easily digestible food that I like. Immediately

after dinner I am accustomed every day to drink somewhat more than a quarter of a pint of Canary wine, to promote the concoction of food in the stomach and to keep away the gout. After dinner I ride in my coach again, and (unless prevented by business) drive two or three miles into the country, to breathe a purer air.

'A draught of small beer serves for my supper and I repeat this when I am in bed and about to compose myself to sleep. My object in taking this draught is to cool and dilute the hot and acrid juices lodged in the kidney, out of which the stone is formed. . . . I am careful to go to bed early, especially in the winter, nothing better than early hours to preserve that order and even course of life which we owe to Nature.'[1]

Dr. Payne thinks that Sydenham, like his great contemporary John Milton, enjoyed the solace of an evening pipe of tobacco.

Sydenham's independent ways, his facetious humour, his frank criticism of many of his fellow practitioners, and his introduction of new methods of practice, seem to have led to some degree of unpopularity in his profession, and to this he often refers in his writings. No doubt it depressed him; possibly it and his puritanical views debarred him from the fellowship of the College of Physicians, but it had little effect upon his high reputation even during his lifetime. Many stories of his sayings, which lost nothing in the telling, became current. In his essay on Sir Richard Blackmore, Samuel Johnson tells us that when, as a medical student, Blackmore enquired of Sydenham what authors he should read, he was directed to 'Don Quixote', 'which' said Sydenham 'is a very good book. I read it still'. Johnson adds, 'The perverseness of mankind makes it often mischievous in men of eminence to give way to merriment'; but probably Sydenham meant no more than to say, 'It is

[1] 'Thomas Sydenham', by J. F. Payne, pp. 186–187.

not books, but clinical study, you need. If you want an interesting author, read Cervantes'. Similarly Sydenham teased Hans Sloane, who as a young man was commended to him as a good botanist and skilful anatomist. Sydenham looked hard at the young man, and said: 'This is all very fine—anatomy, botany. Nonsense! Sir, I know an old woman in Covent Garden who understands botany better, and as for anatomy, my butcher can dissect a joint full as well; no, young man, all this is stuff; you must go to the bedside, it is there alone you can learn disease.' There are many such stories. Sydenham's humour also shows itself in light touches in his writings. 'Gout rarely attacks fools,' he says, but 'those who choose may except the present writer.'

The witty Sydenham was not, however, the real Sydenham. The convinced Puritan of the seventeenth century took himself very seriously, and when one thinks of Sydenham it is of a grave figure, a great and good man of Miltonic mould, dedicated to noble purpose as one under marching orders,

'who through a cloud
Not of war only, but detractions rude,
Guided by faith and matchless fortitude,
To peace and truth thy glorious way hast plough'd.'[1]

When Milton came to manhood he tells us he pledged himself to high endeavour, and that whatever befell, and whether life were long or short, he was under command.

'Yet be it less or more, or soon or slow,
It shall be still in richest measure even
To that same lot, however mean or high,
Toward which Time leads me, and the will of Heaven;
All is, if I have grace to use it so,
As ever in my great Taskmaster's eye.[2]

[1] Milton's sonnet on 'Cromwell'.
[2] Sonnet on 'Age of Twenty-Three'.

That is the sentiment which one cannot escape as one reads Sydenham's little old books. Gardiner, the historian of Cromwell, said that it was a ' condition on which all strong intellectual and spiritual movements rest that they shall be spontaneous. They win their way by force of inward conviction, not by authority.' Thomas Sydenham, the Reformer of English Medicine, was the embodiment of the two immortal ideas of Hippocrates—love of craft and love of man.

In his profession Sydenham was craftsman and philosopher. He pursued the scientific method of observation and induction. He turns always, in his own words, ' from the abyss of cause to the daylight of effect '. Without speculation he deals with what he sees and knows by observation. In method he is inductive ; in philosophy he follows Locke and Bacon. He had sympathy with Locke's ' science of consciousness ', and would have understood the modern philosophic concept of ' purposive striving ' rather than that of ' behaviourism '. His scheme of diagnosis and treatment had always to answer the twofold question, is it true ? and does it work ? Thus he became a sort of pragmatist. ' It is my nature' he writes ' to think where others read ; to ask less whether the world agrees with me than whether I agree with the truth.' He had read in Bacon that the systematic and wide examination of facts was the first thing to be done in science, and that until this had been done faithfully and impartially theories and generalizations must be adjourned. ' The intelligent, patient, persevering cross-examination of things, and thoughts about them, is the only way to know.' It is obvious he did not always collect the relevant facts, nor did he in any case collect enough to sustain his far-reaching inductions. But he went farther on the journey than any other practitioners of his day. His straightforwardness made him see that to follow the principles of Hippocrates meant reality and thoroughness ; it meant facts and not speculation ;

it meant getting away from books and tradition to his patient. 'He is best skilled as practitioner who most diligently and accurately attends to the natural phenomena of disease'—both for diagnosis and for treatment—not Galen or another, not tradition or speculation, but, like Vesalius and Harvey, back to Nature. This was his vision, and to this he boldly declares 'I wholly devoted myself'. At the end he was able to say that he had 'postponed all things to the advancement of medical knowledge, no matter by whom'. In his 'Essay' in 1690 Locke places him, alongside Boyle and Newton, as one of the master builders in the commonwealth of learning. He first set the example in England of true clinical and epidemiological methods.

Then in his love of man Sydenham was above all things a great Puritan. He believed in the dominance of Parliament and in the triumph of Puritanism, and he lived to see both achieved. His Puritanism meant toleration of all forms of faith, single-minded devotion to truth and to duty, good citizenship, and a sense of direct responsibility to his Maker, from which he believed no priest or Church, no creed or vows, could absolve him. These were not fleeting opinions, but fixed convictions, out of which his life and action grew spontaneously. The Renaissance was his occasion, Oxford gave his mind direction, but he became lord of his own event. And he triumphed through character. He was not a roving genius like Leonardo da Vinci or Thomas Young; nor a discoverer like Harvey or Newton or Pasteur; nor yet an epoch-making generalizer like Darwin. He was but a great medical practitioner, and withal a Puritan, a rebel, and an independent. But he did a mighty work, for he laid for all time the foundation of the practice of clinical Medicine. He saw his task, and, heavily burdened, he bent himself solemnly to its fulfilment, yet not without resource. Leaving his fame in the hands of others, he says, 'I have weighed in a nice and scrupulous balance,

whether it be better to serve men, or be praised by them; and I prefer the former.'

Uttered or unexpressed, every man of action has his source of power. Each age adopts different terms for its representation, and one age cannot wisely judge another. The seventeenth century was a time of religious ferment and much vocalization. Big, dull folios and tedious tomes remain to us, yet in the morning of their creation, when fresh and green, they brought a living message to the hearts of men. Both Harvey and Sydenham were the writers of little books—surely among the most precious little books in all the world—in which they have hidden a spiritual legacy. Scattered through Sydenham's writings are references to his thoughts about divine things and divine aid, and in the preface of the first edition of his first book he says this:

'Whoever applies himself to Medicine should seriously weigh the following considerations: first, that he will one day have to render an account to the Supreme Judge of the lives of sick persons committed to his care. Next, whatever skill or knowledge he may, by the divine favour, become possessed of, should be devoted above all things to the glory of God, and the welfare of the human race. Moreover, let him remember that it is not any base or despicable creature of which he has undertaken the care. For the only-begotten Son of God, by becoming man, recognized the value of the human race, and ennobled by His own dignity the nature He assumed. Finally, the physician should bear in mind that he himself is not exempt from the common lot, but subject to the same laws of mortality and disease as others, and he will care for the sick with more diligence and tenderness if he remembers that he himself is their fellow sufferer.'[1]

[1] 'Methodus Curandi Febres', Preface of First Edition, 1666 (Dr. Payne's translation).

These words express Sydenham's *religio medici*. But an unpublished and unfinished manuscript fragment found after his death, and now in the University Library at Cambridge, sets out at greater length Sydenham's thoughts on natural religion. It is designed to prove the existence of God, the immortality of the soul, and the dependence of the human upon the divine. At what streams of living water did Sydenham quench his thirst? Had he read at Oxford, in the 'Anatomy of Melancholy', the words which quaint old Robert Burton, student of Christ Church, had written in 1621?

'God works by means, as Christ cured the blind man with clay and spittle. *Orandum est ut sit mens sana in corpore sano*. As we must pray for health of body and mind, so must we use our utmost endeavours to preserve and continue it. Some kind of devils are not cast out but by fasting and prayer, and both necessarily required, not one without the other. For all the physick we can use, art, excellent industry, is to no purpose without calling on God; it is in vain to seek for help, run, ride, except God bless us. Hippocrates, an heathen, required this in a good practitioner, and so did Galen.'

Or did he learn religion from the innumerable sermons and exhortations to which he listened in the great Church of St. Mary? Or was it from the enquiring minds of Locke or Bacon? Or was it born in the deeps of his own Puritan soul that religion and life must be one thing, for religion is a growth out of the whole nature of man?

Sydenham died on December 29th, 1689, at his house in Pell Mell, and three days later his body was laid to rest near the south door of St. James's Church, Piccadilly. And one hundred and twenty years afterwards the College of Physicians, which did not, in his lifetime, receive him into its full fellowship, wrote above his grave, '*Medicus in omne aevum nobilis*'.

List of Dates relating to Dr. Thomas Sydenham

1624 Birth of Sydenham at Wynford Eagle, Dorsetshire.

1642 Entered Magdalen Hall (Hertford College), Oxford.

1643 First term of military service (4 years).

1646 Resumed studies after Civil War. Fellow-Commoner at Wadham College, Oxford.

1648 M.B. (Oxf.). Fellow of All Souls.

1649 Bursar of All Souls. First suffered from gout.

1651 Second term of military service (? 6 months).

1655 Resigned Fellowship. Married to Mary Gee.

1656 Started practice in King Street, Westminster.

1659 Studied at Montpellier under Barbeyrac.

Some Contemporary Dates

1625 Charles I.

1626 Death of Bacon ('Adv. of Learning', 1605, 'Nov. Org.' 1620).

1628 Harvey's 'De Motu Cordis' published.

1637 Descartes's 'Methode'.

1641 Long Parliament. Evelyn's 'Diary' (1641–1716).

1642–1649 Civil War. Death of Galileo, and birth of Newton (1642).

1643 Sir Thos. Browne, 'Religio Medici'.

1649 Execution of Charles I. Cromwell.

1650 Glisson on Rickets. Death of Descartes.

1651 Hobbes, 'Leviathan'. Burton, 'Anatomy of Melancholy', 5th and complete author's edition.

1655 Death of Sir Theo. Mayerne. Bark first used in England.

1657 Death of Harvey. Pandemic malaria.

1659–1669 Pepys's 'Diary'.

1660 Foundation of Royal Society. Restoration. Boyle's physico-mechanical experiments.

List of Dates relating to Dr. Thomas Sydenham

1661 Death of his father and brother (Col. Sydenham).
1663 Licentiate of College of Physicians.

1666 ' Methodus Curandi Febres ' (to Boyle).
1667 Moved to Pell Mell.

1668 Second edition of ' Methodus ', with Locke's poem.

1676 M.D. (Camb.). ' Observationes Medicae ' (being 3rd edition of ' Methodus ').
1677 Severe attack of gout and calculus.
1680 ' Epistolae Responsoriae ' (to Brady and Paman.)
1682 ' Dissertatio Epistolaris ' (to Cole).
1683 ' Tractatus de Podagra et Hydrope ' (to Short).
1685 Publication of Sydenham's complete works.
1686 ' Schedula Monitoria '.

1689 Death of Sydenham in Pell Mell.

1692 ' Processus Integri ! Dr. Sydenham's Practice of Physick ' (1695).

Some Contemporary Dates

1661 Malpighi, ' Obs. Anat. de Pul '.
1662 John Graunt, Bills of Mortality. Descartes, ' De Homine '.
1665 The Great Plague. College of Physicians burnt in Great Fire (1666).
1667 Milton's ' Paradise Lost '. Hooke, ' Micrographia '.
1668 Mayow, ' De Respiratione '.
1669 Lower, ' De Corde '.
1675 Leuwenhoek on microscopic protozoa. Locke at Montpellier.

1677 Death of Glisson.
1680 Borelli, ' De Motu Animalium '.

1687 Newton's ' Principia '. Petty, ' Essays in Political Arithmetic '.
1690 Locke, ' Essay on Human Understanding '.
1691 Death of Boyle.

3. Hermann Boerhaave

THE DISCIPLES OF BOERHAAVE IN EDINBURGH

¶ *An Address delivered at the Bicentenary Celebration of the Foundation of the Medical Faculty in the University of Edinburgh on June* 11*th*, 1926. [*Reprinted from the Edinburgh Medical Journal*, *July*, 1926, *by courtesy of the Publishers*, *Messrs. Oliver and Boyd.*]

THE DISCIPLES OF BOERHAAVE IN EDINBURGH

A PROLOGUE

I. Salerno, the First Medical School in the West

AS you stand on the heights of Ravello, above Amalfi, there lie before you the blue waters of the Gulf of Salerno. Away to the right is the Tyrrhenian Sea, beyond Cape Licosa; to the left are the bare mountainous spurs of the Apennines, and nestling below them, on the shore, stand the white walls of Salerno, with the Doric temples of Posidonia lying away in the fertile marshes of Paestum, where they were built 500 years before Christ. This sacred spot was the first home of a Greek medical school in the West. Round Licosa Head there came in ancient days the small argosies from the Levant bearing merchandise from the East, and with their cargoes precious manuscripts from Alexandria, Constantinople, and the islands of the Aegean. Down those steep gorges on the north came the doctors from the Roman world, with their Latin translations of Hippocrates, and across those Calabrian hills to the south the apostles from Magna Graecia, the descendants of Alcmaeon and Pythagoras. In that venerable city they first taught their profession, and in those same temples they worshipped their gods and prayed for healing at their hands.

'In summer time the sea breeze fills
With its coolness, cloister and court and square.
Then at every season of the year
There are crowds of guests and travellers here;
Pilgrims, and mendicant friars, and traders
From the Levant, with figs and wine,
And bands of wounded and sick crusaders
Coming back from Palestine.'

'*The Golden Legend*'.

There was to follow later on the mighty sweep of Arabian Medicine, but its tide was not yet due. For 200 years (*circa* 850–1050) the primitive school of Salerno remained the one centre of pure Greek inspiration in Europe. It was not a University, and had no organized Medical Faculty. It was an isolated factor in the educational polity of the early Middle Ages, with no direct influence upon the form or nature of academic institutions.[1] Nevertheless, in the thirteenth century Frederick II of Sicily ordered by royal decree the exclusion of unlicensed practitioners, and laid down by ordinance the period and character of medical education. 'The Salernitan masters' says Neuberger 'were the first in the Christian West to establish an independent nursery of Medicine, serving the interests of science only where all branches alike found recognition; they strove by practical instruction and didactic literature to make their knowledge and capacity common property; they ennobled the healer's art and established precedents which bound to unalterable standards all who wished honourably to bear the title of physician.'[2] They studied anatomy on the bodies of swine, their physiology was dominated by Galenical doctrine, their pathology was founded on the cardinal 'humours', and they first taught the art of surgery in the West. But both in principle and practice they were Greeks, and pursued the Hippocratic tradition.[3]

What exactly was that tradition? Its principle of diagnosis was founded upon pure inductive reasoning,

[1] 'The Universities of Europe in the Middle Ages', by Hastings Rashdall, 1895, Vol. I., pp. 75–86.

[2] 'History of Medicine', by Dr. Max Neuberger, 1909.

[3] The world-renowned 'Regimen Sanitatis Salernitanum' was a composite didactic poem of the twelfth century, which incorporated the ideas of the Hippocratic aphorisms in popular form. The 'Regimen' was universally read, and many of the medical and surgical teachers of Salerno travelled afar to disseminate their doctrines.

and upon observation and experience of Nature. Its purpose was to observe minutely and patiently, and to record accurately and shortly, the essential features which Nature manifested in the patient; to be sceptical of the unverifiable; to generalize only from actual facts and proved experience. That is the Greek foundation of clinical Medicine. Therapeusis was to be based upon personal hygiene, dietary, and mode of life. Nature was held to be the source of healing as well as the accepted origin of disease. Its powers were to be aided, directed, and supplemented, but not thwarted or displaced, by artificial and empirical intervention. That is the foundation of Hippocratic treatment. The Salernitans established independence in their medical practice, free from civic or ecclesiastical control, and they continued to express themselves in the ideas and language of Greece. 'Deservedly then' says Sir Clifford Allbutt 'the school received the name of the *Civitas Hippocratica*.'[1] It was the first great forerunner of Edinburgh.

II. The Greek Spirit Carried to Padua

Greek Medicine, having come to its zenith in Hippocrates of Cos, flowed through the world in four main channels. It flourished at Alexandria under the Ptolemies (who collected together the Corpus Hippocraticum), and thence passed to Rome with Asclepiades and Galen of Pergamum; it spread east from Byzantium; it established itself in Salerno and Magna Graecia; and finally, in Oriental guise and in the teaching of Rhazes, Ali Abbas, and Avicenna, it covered the whole Moslem Empire. Its purest stream was no doubt at Salerno, but its strongest current was Arabic. In the ninth century the Arabs were the masters of half the world, and, though not originators, shrewd transmitters of

[1] 'Greek Medicine in Rome', by Sir Clifford Allbutt, 1921, pp. 424–441.

learning. Of all the invaders who competed for the vestigial remains of the Roman Empire they alone pursued science, becoming the legatees of Greek Medicine. They added to this medical legacy their own lore of botany and chemistry, they enlarged its primitive pharmacopoeia, and they mixed with it the doctrines and prejudices of their astrologers, alchemists, and Aristotelian philosophers. Unquestionably by such additions, and by innumerable translations—from Greek to Syriac, from Syriac to Arabic, from Arabic to Latin—they transmuted much of the genius of the Greeks, but unquestionably also they covered the world with their thought. Graeco-Arabic learning came to Italy, and, absorbing Salernitan Medicine, entered the rising Universities; it found its way through North Africa to Spain, and so to Montpellier; like others before and since, it passed into Mesopotamia.

Although the Medical School at Salerno could not and did not exercise a direct formative influence on the foundation of the Italian Universities, it gave them their medical spirit and it contributed to their scientific character. But its elements were absorbed in the Graeco-Arabic amalgam. By the thirteenth century, Bologna and Padua, though established as 'student universities' for the study of law, possessed medical faculties. These two medical schools became the famous forerunners of Leyden and of Edinburgh. They sprang out of the intellectual reforms which were part of the political and municipal renaissance of Italy. This origin not only kept alive Roman law and jurist practice, formative elements in the structure of the Italian Universities, but gave the municipality a predominant place in the governance of the University. The medical tradition was Graeco-Arabic, though its deficiencies were manifested and its advantages obscured. Then, as now, teaching was directed by the standard of examinations, and we know that the principal books prescribed at

Bologna were the 'Aphorisms' of Hippocrates, the 'Ars Parva' of Galen, the 'Canon' of Avicenna, parts of the 'Almansor' of Rhazes, and the works of Averroes. The last-named author exerted a materialistic effect, wholesomely antidotal to the speculative tendency of the time. Lastly, the fundamental subject cultivated at both these schools was human anatomy and physiology, a subject neglected by the Greeks and Romans. For twenty years from 1306 Mondino taught the subject at Bologna, recalling the Alexandrian study of *human* anatomy.

His 'Anatomia' (1316) became the text-book for two centuries, until Padua, and the whole medical world, sat at the feet of Vesalius during his five great years as Venetian Professor of Anatomy. His 'Fabrica' (1543) took men back to Nature and to the Greek spirit. It was copied, not from letterpress, but from the body of man. It is one of the supremely great books in the whole history of Medicine, and opened the doors of a new kingdom.[1]

III. The Influence of Padua on Leyden

From all nations men gathered within the brown walls of Padua to become disciples of Vesalius, and his book passed all through Europe and was reprinted in Leyden. It heralded the Medical Renaissance. In the year of its publication Jan Heurnius was born at Utrecht. He was educated at Louvain and Paris, and in 1567 he went for four years to study Medicine at Padua under Fabricius, the third successor of Vesalius, and one of the greatest of all teachers of anatomy. After his return from Italy, Heurnius settled in practice at Utrecht, but in 1581 he was called to the Chair of Medicine

[1] See also 'The Evolution of Anatomy', by Charles Singer, M.D., 1925.

and Anatomy at the University of Leyden, which had recently been founded (1575). There he taught for many years, modelling his work on Padua and his ideals on Hippocrates. He was the first to make anatomical demonstrations of the human body at Leyden. As teacher of anatomy he was followed by other pupils of Fabricius, who likewise carried the torch from Padua to Leyden. Jan Heurnius, however, did much more than bring Vesalian anatomy to the new medical school at Leyden. For it was he who introduced practical clinical teaching in that University, and this, too, he had brought from Padua, where it had been practised in the hospital of St. Francis by Montanus (1488–1551), a friend of Vesalius himself, and developed by Oddi and Bottoni. There were but few beds available in the hospital at Leyden for this instruction, but it was there that the great principle of systematic clinical study and observation by the student himself was introduced on Greek lines by Heurnius and developed by his son Otto, by Sylvius and Bidloo and Boerhaave.[1] And it was by the disciples of Boerhaave that it was carried in two streams, eastward to Vienna, and westward to Edinburgh, and thus to the great medical schools of the New World.

IV. Boerhaave at Leyden

The revival of the Hippocratic tradition came to the Anglo-Saxon race in the seventeenth century, in the life and labour of three men, Harvey, Sydenham, and Boerhaave. The first was an investigator, the second a practitioner, and the third a teacher. Hermann Boerhaave was a Dutchman, born in 1668 in the little village of Voorhout, two miles from the Harlem gate of Leyden. His father was minister of the village church and a

[1] See account of this hospital by Van Leersum in *Janus*, December, 1918, pp. 200–205.

good linguist. The lad went to school in Leyden, and at the age of 16 entered the University. Being precocious, he took a degree in philosophy in three years, and was particularly adept in the Greek, Hebrew, and Chaldee languages. Though intended for Divinity, he was turned by a domestic incident to Medicine, and qualified in 1693. He settled in general practice at Leyden, but whilst waiting for patients he continued to study with diligence, having as his ambition the pursuit and mastery of Greek Medicine. After nine years thus spent, he was appointed (1701) to lecture on the Institutes of Medicine in the University, and in a few years had proved himself so accomplished a teacher that at the age of 41 he was appointed (1709) Professor of Medicine, and so gifted an author that his 'Institutiones Medicae' was published at Constantinople, and his 'Aphorisms' and 'Elementa Chemiae' at Leyden. In 1714 he was elected Rector of the University, and also Professor of Clinical Medicine and Chemistry in place of Bidloo, and this post he held until his death in 1738.

In a single generation the reputation of Leyden as a School of Medicine spread through Europe, and wholly supplanted that of Padua. Boerhaave's classroom was crowded with men of many nations, 20 to 30 per cent. being from Great Britain. Leyden had provided an anatomical theatre, a chemical laboratory, a physic garden, and libraries and classrooms, but, though clinical teaching had been carried on for a hundred years, the hospital accommodation was still extremely limited. Nevertheless, Boerhaave used it to full effect. He attended twice a week, brought his students to the bedside, and insisted upon autopsy examinations. He became, both in chemistry and practical medicine, what Haller called the *Communis Europae Preceptor*. He made his modest clinic the grand battleground in Europe between book-learning and practical training. From that little infirmary was to go forth a new method of

medical education.[1] Sir William Osler used to say that Boerhaave's unique position was attained on four grounds. He had an attractive and forceful personality; he was a large-hearted, sympathetic man, and an untiring worker. Then he had also a genius for teaching and exposition, simple, practical, graphic, dynamic, and devoted to the ideals of Hippocrates and Sydenham. Thirdly, he was a prolific author, and, though his learned books are long since dead, they 'had a greater influence than those of any other writer of the eighteenth century'. Lastly, though Boerhaave left little original work behind, he possessed the instinct of research.

In the autumn of 1718 there sat in Boerhaave's class-room eight or ten young men from Edinburgh.[2] They came there partly because Leyden was a Protestant medical school of easy access and favourable terms, but mainly to sit at the feet of Boerhaave, whose fame had already reached Edinburgh, and who was now at the zenith of his power. Among them there was Alexander Monro, a medical student aged 21, designated by his father to be an anatomist, and destined to carry the traditions of Leyden to Edinburgh and to be the founder

[1] See 'Life and Writings of Hermann Boerhaave', by William Burton, M.D., 1743–1746. Also papers on 'Boerhaave's Einfluss auf die Entwicklung der Medizin in Oesterreich', by Max Neuberger, and 'Boerhaave und seine Bedeutung für die Chemie', by Ernst Cohen, at the celebration of the 250th anniversary of Boerhaave's birth at Leyden, 1918. (See *Janus*, December, 1918.)

[2] There had, of course, been many associations between Edinburgh and Leyden before this date. Sibbald (1660), Archibald Pitcairne (1692)—for one year a professor at Leyden—Craufurd (1668), Trotter (1672), Lauder and Matthew St. Clair (1674), Learmonth (1675), Halkett (1675), John Monro (1692), and other Edinburgh men had also studied there. Of the 21 original Fellows of the College of Physicians in 1681, 9 had been students at Leyden. Munk's Roll of the London College of Physicians shows 11 Fellows educated at Leyden in the sixteenth century, 118 in the seventeenth, and 112 in the eighteenth century.

of the Medical Faculty in this University.[1] By his side sat John Rutherford, of the same age, afterwards to become the famous professor at Edinburgh and the grandfather of Sir Walter Scott.[2] In the same classroom that winter there was a Leyden boy of 18 of the name of Van Swieten, who was in after years to carry the same traditions to Vienna and initiate the vast movement which was ultimately to mark the advance of scientific and clinical Medicine in the Austrian and German Empires. Not long was to pass before another boy, aged 17, named Haller, was to sit beside Van Swieten and receive the same generative and enlightening inspiration which he was to hand on to the world in an immortal book. This classroom in Leyden was pregnant with new birth.

V. What the Edinburgh Men brought back from Leyden

We must now ask ourselves: What did these young men bring back from Leyden to Edinburgh in 1719? Their home was in a more beautiful and romantic city

[1] John Monro, father of Professor Alexander Monro (*primus*), was third son of Sir Alexander Monro, and was born at Edinburgh in 1670. He was apprenticed to W. Borthwick, surgeon, and Dr. Christopher Irvine, and went to Leyden in 1692. He served as a surgeon in the Army in Flanders, but settled as a surgeon-apothecary in the High Street at Edinburgh in 1700, joining the Incorporation of Surgeons in 1703. In 1712 and 1713 he was Deacon, and became a member of the Town Council. He conceived the scheme of creating a national medical school in Scotland and determined that his only son Alexander should be the instrument for accomplishing it. He gave him, therefore, every educational advantage to this end, and, while the boy was growing up, he himself was busy arousing enthusiasm for the scheme among his professional brethren and municipal colleagues, especially with Lord Provost George Drummond. ('The Monros of Auchinbowie', by J. A. Inglis, 1911, pp. 54–56.)

[2] 'In April, 1758, my father married Anne Rutherford, eldest daughter of Dr. John Rutherford, Professor of Medicine in the

than Leyden, their own University was of about the same age as that of Leyden, and, like it, was closely associated with the life and governance of their city. In both places there were University professors of botany, chemistry, and medicine, an anatomical theatre, public dissections in anatomy, a chemical laboratory, and a physic garden. But there was one overwhelming difference. In 1718 Leyden was a place of splendid vision, a hive of industry, a centre of life and growth ; and the University of Edinburgh was not. The whole atmosphere at Leyden was vital, the spirit adventurous.

(*a*) *The Impress of a Personality*

For first there was at Leyden in that day a living prophet, and it is men, and not methods, that make a great University. Boerhaave was 50, a big, simple, dignified man, at the summit of his strength, the dominating and dynamic figure in a *studium generale*. He possessed a versatile personality, a keen intellect, a large heart, and true piety. Though not pre-eminently an originator, he was supreme as teacher, a man of wide learning, clear, cogent, and eloquent in exposition, a master of his job, the preceptor of Europe. Almost an evangelist in purpose, his enthusiasm was balanced by his knowledge, and, having stated his case day by day, analytically, he presented it finally to his disciples as a grand synthetic conception of truth. Sir Michael Foster said of him that ' he was a learned scholar and a sound scientific thinker, too all-round a man to be led away by any one idea, however tempting ; essentially eclectic in nature, he gathered truth from every source '.[1] No

University of Edinburgh. He was one of those pupils of Boerhaave, to whom the school of Medicine in our northern metropolis owes its rise, and a man distinguished for professional talent, for lively wit, and for literary acquirements.' (From Sir Walter Scott's Autobiography : Lockhart's ' Life of Scott '.)

[1] ' History of Physiology ', 1901, p. 202.

student, with this wonderful man in front of him, could long remain unmoved. For here, at last, was nothing partial or partisan, nothing listless or unpurposive ; here, at last, was a vision of truth, co-ordinated into a unity ; here were progressive and expansive seminal ideas ; here was a cause worthy of a crusade. We must not forget that the seventeenth century was a time of plague and pestilence, of typhus and epidemic ague in Europe, and men were faced with impending disasters against which they felt helpless. Here was a man who stood in the breach, and seemed to stem the tide and remove the chaos.[1] Harvey was dead and John Hunter not yet born ; nowhere else in all the world at that time was there any such commanding and inspiring figure in Medicine as Boerhaave at Leyden, and it is not remarkable that he won the devotion of men and became an immeasurable power in their lives. Then and there he marked them as his own ; and ever afterward, scattered over the earth, they were ' Boerhaave's men '.

(*b*) *An Appreciation of the Science of Medicine*

The second thing which Leyden bestowed upon the young men from Edinburgh was the gift of an idea, and the idea was no less than an apprehension of the Science of Medicine. Sixty years afterwards, in their own University, William Cullen, the competent critic of Leyden, declared : ' I truly esteem Dr. Boerhaave as a philosopher, a physician, and the author of a System [of Physic] more perfect than anything that had gone before, and as perfect as the state of science in his time would permit of.'[2]

And, again, in his own lectures, Cullen says : ' When Dr. Boerhaave came into the school of Leyden, about

[1] ' Epidemics in Britain ', by Charles Creighton, 1894, Vol. II., pp. 17, 306–335.

[2] ' Life of William Cullen ', by J. Thomson, 1832 (1859), I. 118.

the beginning of this century (1700), he found that school divided between the *chemical* system of Sylvius, and the *mechanical* one of Bellini and Pitcairne. His sagacity perceived the general utility of both, and his discernment selected very properly from each. . . . He thus combined the doctrines of the Mechanicians, the Cartesians, and the Chemists. . . . Possessed of an excellent systematic genius, he gave a system superior to any that ever before appeared, and more generally received than any previous one that had been since the time of Galen.'[1] And he adds: 'When I first applied to the study of physic, I learned only the system of Boerhaave; and even when I came to take a professor's Chair in this University, *I found that system here in entire and full force*.'[2] Now here we have evidence that Boerhaave established a system of Medicine, and that system formed the early foundation of the Edinburgh Medical School. How did it get here? and what was it? The answers are simple. It got here because the young Edinburgh men brought it here from Leyden; and it consisted of selected items from both sides of the grand medical controversy of the seventeenth century, when the authority of Galen ended and the appreciation of the reign of natural law began. Vesalius and Harvey together terminated the Galenical period of 1,400 years. Borelli of Pisa and Sylvius of Leyden were their apostles in the seventeenth century—Borelli became founder of the iatro-mechanical school, and Sylvius of the iatro-chemical school.[3] Boerhaave was the unifier of both schools in the eighteenth century,

[1] 'Works of William Cullen', by J. Thomson, 1827, I. 411.

[2] Ibid., p. 412. 'The Medicine which made the University of Edinburgh famous throughout the world was derived from Holland. . . . The clinical and the systematic Medicine of Scotland were altogether derived from Boerhaave.' ('Hist. of Med. in British Isles', Norman Moore, 1908, pp. 153–155.)

[3] It was chiefly through the advocacy of Sylvius that Harveian doctrines became established in Holland.

for he introduced what became known in Europe as *la Médecine Collective*, what Aristotle called 'the track of the one into the many and of the many into the one'. In the thirteenth century our own Roger Bacon had said that 'all sciences are connected; they lend each other material aid as parts of one great whole, each doing its own work, not for itself alone, but for the other parts: as the eye guides the whole body, and the foot sustains it and leads it from place to place. As with an eye torn out, or a foot cut off, so it is with the different departments of knowledge; none can attain its proper result separately, since all are parts of one and the same complete wisdom.'[1]

Thus it was the students at Leyden in 1718 found their days mapped out for them in a correlated scheme, though not a curriculum, of study designed to weave together into one the current strands of all branches of medical learning. Boerhaave lectured four or five hours a day. He begins with mechanics and physics (I am following his syllabus, which lies before me), but, though a mathematician, he uses them as a means, not an end; he continues with chemistry, but, though a consummate chemist in that age, he does not exalt it above anatomy; he goes on to the morphology of the body, but he will not allow anatomy to answer every physiological question; and he ends with applied physiology as the only way to understand pathology and establish the rational treatment of disease. No coherent picture of this kind had been similarly presented before.

Above all, Boerhaave was a Greek in outlook. He would put to his students this theory or that, expanding and elaborating like Francis Bacon, but always, like Hippocrates and Sydenham, he carried them back to the source, Nature herself. In his famous inaugural lecture, in 1709, he insisted that all true study of Nature must be based upon observation, experiment, and

[1] 'Opus Tertium', 1266.

deduction. For him it was claimed that he was 'the Batavian Hippocrates', as he claimed for Leyden that it was 'the Hippocratic School'. Thus the Edinburgh pilgrims found themselves standing for the first time in their lives, in the direct succession through Padua, Salerno, and Alexandria, with the founders and builders of inductive science. For them it was the dawn.

There was, as I have said, a young Edinburgh man, John Rutherford, aged 21, sitting in Boerhaave's class in the winter of 1718, who made careful notes of the discourse, and thirty years later, as Professor of Clinical Medicine, he reproduced them in his lectures in the Royal Infirmary in Edinburgh.[1] Here are his words taken from his own manuscript preserved in Sir William Osler's library at Oxford:

'A true physician is one who is acquainted with the principles and fundaments of the Art; who understands the animal economy, and not only knows what health is, but can trace out the causes of disease, and the rise of the symptoms. He understands when and where Nature makes an effort, supports her when weak, and works with her as far as he can in all her operations. He may be said to be her minister, and, following her as his guide, varies his practice as the indications change. In short, he acts in everything by reason. Hippocrates advises right when he bids us follow Nature as our guide, and do nothing without her. . . . Boerhaave was a rational physician, and followed Nature wherever she led.'[2]

(*c*) *A Method of Clinical Education*

Lastly, there was a third precious thing which was brought here from Leyden—a method of clinical education.

[1] It was for long the custom of 'Boerhaave's men' in Edinburgh to teach from the notes they had taken at Leyden and to use and recommend Boerhaave's text-books.

[2] Manuscript Clinical Lecture, Royal Infirmary, Edinburgh, John Rutherford, M.D., 1749.

We have already seen in outline the rise and early history of clinical teaching. There was one institution at Leyden which was quite new to the Edinburgh men, the old convent infirmary which Burton calls 'the University Hospital'. There twice a week, for a three months' session, the Professor of Practical Medicine held a bedside clinic 'subservient to the use of the University'. We have a clear account of the practice pursued at this clinic from the pen of one of its chief promoters, the great Sylvius, who was appointed Professor of Practical Medicine at Leyden in 1658. This is what he says:

'I led them by the very hand into the practice of Medicine, that is, I took them daily into the public hospital for the purpose of seeing the sick, to whose complaints and other notable symptoms I directed attention, asking immediately afterwards what they had observed in the disorders of the patients; their views as to the causes and proper treatment, and their reasons for the same. Whenever differences of opinion arose among them concerning these things, I, in a quiet way, pitted against each other those holding different opinions, in order that they might mutually satisfy themselves by as solid reasons as possible drawn from every source, finally giving my own judgment regarding the various views. With me they confirmed the happy results of the treatment, when God rewarded our labours by the return to health of the patients, or assisted in the examination of the cadavers when the patients finally paid the inevitable tribute to death.'[1]

Lucas Schacht, his colleague, fully confirms this account.

It is interesting to leap the years, and find from Rutherford's manuscript notes that when he introduced clinical

[1] 'Epistola Apologetica', 1664.

teaching here at Edinburgh, he followed the exact model which he learned from Boerhaave in the hospital ward at Leyden in 1718–1719. We have a list of his clinical lectures (illustrated by patients) in 1749, and this comment on his method:

'The method I propose to pursue is to examine every patient before you, lest any circumstance should be overlooked. I shall conduct this by a plan which will be the most useful I can think of. I shall give you the history of his disease in general; second, enquire into the cause of it; third, give you my opinion how the disease is likely to terminate; lay down the indication of cure which will arise; or when any contrary symptom arises you shall have notice of it; that you may see the reason of altering my prescriptions. I shall point out the different methods of cure, but as I shall give my opinion freely, if you find me mistaken I hope you will excuse me, for the Art of Physic is not infallible, nor do I myself by any means set up for infallible. I shall make as accurate observations and as just conclusions from them as I can. I hope this will produce a good result and help to make you real Physicians.'[1]

Thus was introduced the bedside clinical teaching, which, with all its subsequent developments of clerking and dressing, became one of the characteristic features of the Edinburgh School, and which has been copied all over the world.[2] It is, in principle, as old as Ionian Medicine, but here it was organized as a systematic training, and on a scale hitherto unknown.

[1] Clinical Lectures in Royal Infirmary, Edinburgh, John Rutherford, M.D., 1749.

[2] See 'Life of William Cullen', by J. Thomson, 1832 (1859), pp. 103–105; and Sir Norman Moore's 'History of the Study of Medicine in the British Isles', 1908, pp. 153–157.

VI. The Foundation of the Medical Faculty at Edinburgh

The early days of the medical history of Edinburgh have been fully recorded[1]—they were presented succinctly only the other day in the public Press by the distinguished President of the Royal College of Surgeons —and it will be sufficient here to recall to remembrance the outstanding facts. In 1505 the Guild of Barber-Surgeons received a charter from the Town Council, ratified in the following year by James IV. The applicant for admission to the Incorporation was to be examined in the 'anotomia of manis bodie', and the surgeons were to have one corpse per annum for dissection. One hundred and seventy-six years later the physicians, after four abortive attempts, were successful, through the good offices of Robert Sibbald[2] and Archibald Pitcairne (described in Greyfriars as 'prince of physicians'), in obtaining a charter, in 1681, for the patent incorporation of their twenty-one fellows.[3] Both colleges played an important part in the foundation of an extra-mural

[1] 'Historical Sketch of the Edinburgh Anatomical School', by John Struthers, M.D., 1867; 'The Story of the University of Edinburgh', by Principal Sir A. Grant, 1884 (2 vols.); 'Early Days of Royal College of Phisitians of Edinburgh', by R. Peel Ritchie, M.D., 1899; 'The Edinburgh School of Surgery', by Alexander Miles, M.D., 1918; 'Edinburgh's Place in Scientific Progress', 1921; 'Early Anatomical Instruction at Edinburgh', by J. D. Comrie, M.D. (*Edinburgh Medical Journal*, December, 1922); 'The Royal College of Surgeons of Edinburgh', by C. H. Creswell, 1926.

[2] Robert Sibbald, to whom Edinburgh owes so much, was born there in 1641. He was educated at Cupar, in Fife, and subsequently at the Royal High School. He went to Leyden in 1660 (1½ years), Paris (9 months), and Angiers (M.D. 1662); began practice in Edinburgh in 1663, and was concerned in the establishment of the Physic Garden (1666) and the College of Physicians (1681). In 1682 he was knighted, and appointed Physician to Charles II and King's Geographer for Scotland; President of the College of Physicians (1684) and Professor of Medicine in the University (1685). Died about 1721–1722.

[3] 'Remains of Sir Robert Sibbald', 1837, pp. 21 and 29.

medical school, and ultimately of a Medical Faculty within the University. Their influence, however, ebbed and flowed like the sea-tide. Sibbald and Andrew Balfour were instrumental in establishing a small physic garden in 1670 at Trinity Hospital, near Holyrood, and in 1676 a Professor of Botany was appointed by the Town Council. This was the first medical chair in the University. It was followed in 1685 by the appointment of Sibbald himself as Professor of the Practice of Physic, in which he was shortly joined by Halkett and Pitcairne. Meanwhile, the College of Surgeons acquired powers by royal patent, in 1694, for the furtherance of the teaching of anatomy and the building of an anatomical theatre, that Edinburgh might have better facilities than existed at Leyden, whence Pitcairne had just returned. Special teachers of anatomy were appointed (Eliot, 1705, Drummond, 1708, and M'Gill, 1716), and provision was made for dissection by the apprentices. Lastly, in 1713, a Chair of Chemistry was founded, and James Craufurd, one of Boerhaave's pupils at Leyden, was placed in it. Three points should be noted. These professors were appointed by the Town Council on their own application as practitioners; they did little or no teaching, and received little or no remuneration; and, thirdly, no substantial progress in anatomical or medical science had been made during the two centuries which had elapsed since 1505. This was owing to the poverty and distracted state of Scotland, whilst in Italy and Holland immense progress had been made. The 'Fabrica' of Vesalius came in 1543, and Harvey verbally announced his discovery of the circulation of the blood in 1616 (though 'De Motu Cordis' was not published until 1628).

This was the condition of things when Alexander Monro and his Edinburgh comrades came back from their baptism at Leyden in 1719. In November of that year Monro was admitted to the College of Surgeons,

and in January of 1720, on their recommendation, he was elected by the Town Council, at the age of 22, Professor of Anatomy in the University. He held his classes at Surgeons' Hall, and Rutherford, St. Clair, Plummer, and Innes—all Boerhaave's men—joined him there, and held classes in medicine and chemistry. When Monro removed to the University buildings in 1725, because of an uproar in the city on the subject of body-snatching from Greyfriars Churchyard, they petitioned the Town Council to be made professors in the University, and such appointments the Council made on February 9th, 1726. Hence the Medical School of the University was formed by the transference of this group of extra-mural teachers from the old Surgeons' Hall.

On their return to Edinburgh there was one thing in particular of which they felt the lack—a hospital in which students could be taught clinical Medicine in systematic fashion. Whilst Alexander Monro was getting into his stride as a professor at Surgeons' Hall, his father was cogitating the establishment of the Royal Infirmary. With the help of the College of Physicians and the energetic co-operation of Lord Provost Drummond and Professor Monro, a house was temporarily leased in Robertson's Close, in 1729, as a small hospital for treatment and clinical study. In 1738 were laid the foundations of a permanent infirmary, which was opened in 1741, and used for teaching almost immediately. It was not a cheerful or exhilarating institution, but within its sombre walls was achieved an advance in clinical Medicine and Surgery which brought enduring fame to Edinburgh. Here began, in the second half of the eighteenth century, the Edinburgh School of Surgery, founded upon anatomy, for here Benjamin Bell, Lizars, Fergusson, Liston, Syme, and Lister did their brilliant work. Here also worked Rutherford, Cullen, and Gregory, the Fathers of Edinburgh Physic.

Thus was fulfilled the dream of John Monro, the Edinburgh surgeon (who had himself studied at Leyden in 1692), that his only son Alexander should be the founder of a national medical school of University standing.[1] Thus was brought, through Salerno, and Padua, and Leyden, the Greek inspiration of Medicine, to be embodied in this ancient city in the greatest medical school of its age, at that time the glory alike of the University and of British Medicine.[2] It is that event we celebrate here to-day.

As we look back we see the struggles and travail, the controversies and disputations, inevitable to a great constructive period of two centuries. It is in the conflict of opinion that truth is found. We see also conjoint action and co-operation, the track of the many into the one; a town council and a town college, both of them catholic and communal in their interest, are here combined in a vast educational effort in a University institution for the betterment of man's estate in a commonwealth, as free from political as from ecclesiastical control, and singular among the Universities of Scotland in being created by the will of the citizens rather than by the mandate of a papal decree.[3] It was this democratic origin which gave to the Edinburgh Medical School its early method of appointment to academic Chairs on the initiative of the applicants themselves as well as by the

[1] 'The Monros of Auchinbowie', by J. A. Inglis, 1911, p. 54.

[2] There was no other complete University Medical School in the British Islands, though Oxford had a Professor of Medicine in the fourteenth century and Cambridge in 1540. The first University Medical School in America was founded at Philadelphia in 1765 on the Edinburgh model. In London, Fordyce, Cheselden, the Hunters, Baillie, Blizzard, and others had carried on proprietary schools of chemistry, anatomy, and clinical subjects. (See Peachey's 'Memoir' of the Hunters, 1924.)

[3] The University of St. Andrews was founded in 1413 under a papal bull of Benedict XIII; that of Glasgow in 1450 under Pope Nicholas V; and that of King's College, Aberdeen, in 1494, under Alexander II

will of the Academia, and it brought into the scheme, not only the extra-mural teachers, but also the co-operation of the Colleges of Physicians and Surgeons. Once more we see an Oriental mosaic, a design of cut-glass or precious stones of many colours, brought to this northern home from Greece and Alexandria, from Arabia and Italy and Holland, transmuted and skilfully pieced together by master craftsmen of many races and of immortal names, and made glowing and radiant by the light of Scotland, enriched by her faith.

VII. The Work of Two Centuries

It is only the folk who live on the top stories of the Old Town who obtain a bird's-eye view of Fifeshire and the Forth, and it is only as we look down on the two centuries from historical heights that we shall obtain a true prospect of their ground-plan. In the first place there is this ancient royal city, the capital of Scotland. It was her condition which made the foundation of the Medical Faculty possible, and it has been her condition over ten generations which has left an indelible mark upon its character. By means of old engravings, charts, and records, we can visualize Edinburgh before 1763, when the North Bridge was built, extending the Old Town to the open country between itself and the sea.

(Rashdall, loc. cit., II. 295–315). Edinburgh alone was initiated by the municipality and ministers of the city, and the Town Council acted as its first Chancellor. Its declared purpose was ' for sustaining the true ministers of God's word, founding and building hospitals for the poor, and colleges for learning and upbringing of youth, and other such godly works '. It was a Lord Rector who said : ' Mighty are the Universities of Scotland, and they will prevail. But even in your highest exultations never forget that they are not four, but five. The greatest of them is the poor, proud homes you come out of, which said so long ago : " There shall be education in this land." She, not St. Andrews, is the oldest University in Scotland, and all the others are her whelps.' (Sir J. M. Barrie's Rectorial Address at St. Andrews, 1922.)

The Union between England and Scotland in 1707 emptied Parliament House of its legislators and the mansions in the High Street of the Scottish nobility, and in marched the people. After the Jacobite Rising of 1745 the New Town was built, and in 1789 the University buildings in South Bridge were begun. Before that day the Medical School was housed in the mean and crowded purlieus of the old College, just within the Flodden Wall. There it remained for seventy years. Broadly, therefore, we must think of the first century of the Faculty as belonging to the Old Edinburgh, and only the second to the New. Meanwhile, into the narrow wynds and courts of this medieval fortress had come a spirit of revival, both scientific and literary. It has often been asserted that the Scottish tide of scientific thought flowed in from England of the Restoration, though the literary genius was native born. We have already seen, however, that the main stream of science came through Leyden. Apart from that, Edinburgh became in the eighteenth century a centre of learning, a place of intellectual renaissance unsurpassed by any other in Europe. This repute was of invaluable benefit to its Medical School. From its earliest days it was never a proprietary school, never a hospital school, never only a polytechnic. It was a central School of Medicine,[1] self-contained and

[1] 'Amongst the reasons for the success of the Edinburgh School was the fact that *all the University teaching was grouped around one centre*. Successful University professors were thus inspired by having to address themselves to much larger classes of students than were then, or for the matter of that are now, ever assembled at any of the London Medical Schools. This was a great stimulus; and there was another of perhaps equal potency. Teachers who held no official appointments were permitted to give independent courses called "extra-mural", attendance on which was allowed to count instead of the ordinary University lectures. This had a double advantage of keeping University professors up to the mark and of training the younger for teaching whenever a professorship fell vacant.' (Sir Rickman J. Godlee in 'Life of Lord Lister', 1917, p. 33.)

relatively complete, an organic part of a University, itself a child of the Reformation, born of the political, municipal, and religious aspirations of a people convinced of the necessity of a liberal education.

It cannot be doubted that this liberalism was inspired by the great men, some of them statesmen and some of them prophets and seers, within and outside the University who gave it form and character.

> 'With more than mortal powers endow'd,
> How high they soared above the crowd!
> Theirs was no common party race,
> Jostling by dark intrigue for place;
> Like fabled gods, their mighty war
> Shook realms and nations.'[1]

Principal Carstares (1703–1716) and Lord Provost Drummond stand in the front rank. Carstares was the internationally minded statesman who remodelled the University upon the Dutch national type, Drummond the citizen who as master builder of municipal enterprise was the chief lay initiator of the Medical School. They both exerted a direct formative effect both upon its organization and upon the direction of its growth. Other imponderable but not less operative influences were at work. Allan Ramsay, Robert Fergusson, and Robert Burns were the forerunners of a literary movement which culminated in the immortal Sir Walter Scott, of whom Lord Cockburn said, 'Scotland never owed so much to one man'. Hume, Reid, and Adam Smith began a philosophic movement in Scotland, later carried on here by Dugald Stewart, John Playfair, and Sir William Hamilton.[2] William Robertson, the historian of Scotland,

[1] Sir Walter Scott's 'Marmion'.

[2] Among the Edinburgh teachers who urged the necessity of a study of logic and philosophy for all medical students were Cullen, Thomson, Chalmers, and T. R. Fraser.

became Principal of the University in 1762, and was in the van of those who originated the intellectual movement. He governed the University for thirty years, and lived to see the new buildings commenced.

In 1802 came the *Edinburgh Review* under Jeffrey, Sydney Smith, and Brougham—three young men who did much to stimulate the critical spirit in Edinburgh, whilst Thomas Campbell, the poet, Mackenzie, 'the man of feeling', De Quincey, 'Christopher North' (John Wilson), and Lockhart (*Blackwood's Magazine*, 1817), improved the shining hour by their literary talents. Nor must we allow ourselves to forget the dynamic influence exerted by Thomas Chalmers, Thomas Guthrie, and many fervent religious leaders. Intense movements like the Solemn League and Covenant, the Jacobite Risings, and the Disruption of 1843, expressed a virility of spirit which vitalized the nation.

'Times
Whose echo rings through Scotland to this hour.'

'Great causes create great men,' said Lord Cockburn, 'but great men elevate great causes.' It was this interaction which did so much for Edinburgh in the eighteenth and nineteenth centuries.[1] It not only marked the Medical Faculty, many of the professors of which shared in and contributed to the intellectual life of the city, but it created for the students a stimulating atmosphere, and gave them a mental environment in which their professional education became liberalized. From all over Great Britain, and from remote parts of the earth, men came to be nurtured in this cosmopolitan centre, and thus attained to a sense of citizenship of the world.

In the second place, the two centuries have been characterized by a double contribution to the science and art of Medicine. There has been established on

[1] 'Journal of Henry Cockburn' (1831–1854), 1874 (2 vols.).

Boerhaave's principles, but rightly enough advancing beyond them, a method of fundamental education which has commended itself to the profession of Medicine in all nations. The first great exponent was Cullen, whose name and influence were dominant in the eighteenth century. He laid down in his nosology a basis of classification of disease, which remained current for a century, and in his ' First Lines of the Practice of Physic ' he produced an authoritative text-book of diagnosis and treatment. One other great reform he initiated. ' He dethroned Disease,' said Clifford Allbutt, ' and set up the Patient; he distrusted systems, and saw that the only real is the individual.' Both his love of order and common sense and his instinct for teaching became a tradition in this University, and to that tradition of teaching no small share of its massive achievement must be attributed. ' The glory of a professor ' said Barrie ' is to give elastic minds their proper bent.' [1] Never has there been a time in its long history when the Faculty did not possess competent masters in the art of exposition, and this one fact has been its continuing security. In all the chief subjects of the curriculum, both medical and surgical, through the two centuries, Edinburgh has provided a *school* of method. In theory and in practice the training here has been first a discipline, and secondly an imparting of knowledge. This design is now obvious, but its establishment 200 years ago was due to far-seeing sagacity.

The second part of the twofold contribution has been the advancement of medical knowledge. Naturally enough, this began with anatomy and chemistry, the two subjects primarily undertaken in a school instituted on the Leyden model. The first Monro was preoccupied with teaching and organization, but his son added substantially to our knowledge of human anatomy and extended it to comparative anatomy, concurrently with

[1] ' An Edinburgh Eleven ', by J. M. Barrie, 1889, p. 17.

a similar extension in John Hunter's school in London. The first original researches of Monro *secundus* were undertaken by him as an undergraduate, aged 22, and prepared as a thesis for M.D. in 1754. At the same time, Joseph Black, aged 26, furnished a thesis on his discovery of 'fixed air', afterwards called 'carbonic acid gas', and in 1772 Daniel Rutherford, aged 22, wrote his graduation thesis on his discovery of nitrogen. Thus did three young men open the doors of epoch-making scientific progress at Edinburgh in the eighteenth century.[1] Charles Bell, who was born in East Lothian, became one of the earlier physiological discoverers of the nineteenth century, for as a young man of 24 he began here the studies which led subsequently to his organized exploration of the function of the anterior and posterior roots of the cerebro-spinal nerves. More than thirty years passed before he returned to Edinburgh (1804–1836), and during that period new Chairs had been established in the University in surgery, medical jurisprudence, and pathology, and there was immense practical activity in many directions, in which Andrew Duncan, Alison, and Sir R. Christison took a large share. Christison was made Professor of Medical Jurisprudence in 1822, and in the following year announced his investigations into poisoning by oxalic acid, the beginning in Edinburgh of the new science of toxicology.[2] Christison has been described as 'the noblest Roman of them all', and whether in the Chair of Medical Jurisprudence or that of Materia Medica,

[1] A valuable auxiliary movement was the Royal Medical Society, initiated in 1734 and founded in 1737.

[2] Christison, like a number of the Edinburgh teachers in the early nineteenth century, went to France (1820) to study under those who were at that time making the Paris school famous, and there he derived many ideas for the improvement of forensic medicine and toxicology. The Paris school had lost Bichat in 1802, but it still had Broussais, St. Hilaire, Dupuytren the surgeon, and the chemist Gay-Lussac. Pinel was 65, and still supreme on insanity ; Orfila was

he actually served as a professor for fifty-five years, one-sixth of the whole history of the University, more than one-quarter of the history of the Medical Faculty.[1] During his term of office he witnessed the work of Goodsir on the cell theory, of Gregory on morphia, of Hughes Bennett on leucocythaemia, of Laycock on hysteria and morbid psychology, of Sir James Young Simpson on the anaesthetic power of chloroform, and of Joseph Lister on antiseptic surgery.

These discoveries, like all discoveries, were but stages in the pursuit of truth. They did not begin, nor were they completed, here, but all of them were here substantially advanced, and of two of them it may be said, they entered into the history of mankind.

VIII. The Future of the Edinburgh School

We can hardly join together to-day in commemoration of the glorious past without turning our faces for a moment to the future. Its security is ensured if we will but follow the example of our forefathers; and the genius of the past is not remote from us. Indeed, though I have avoided mention of the living leaders of the Faculty, it is very nigh and in our midst. Other and better men have gone before us, and we enter into their labours; other and better men will follow us, and enter into ours. One thing is certain—the education and

professor of medical jurisprudence; Magendie, the successor of Charles Bell, was in his prime, and represented experimental pathology and pharmacology, and Laennec was physician at the Neckar and had invented the stethoscope (1819). Pierre Louis was rising to fame, Cuvier, Trousseau, Dumas, and Claude Bernard were yet to come. The Paris school exerted a valuable influence on Medicine at Edinburgh in the early nineteenth century. ('Commisssion on Universities of Scotland', 1826; Report, 1837, II. 467.)

[1] Thomas Richard Fraser followed Christison, and fulfilled a long career of investigation into experimental pharmacology, adding to our knowledge of plague in India, of snake poison, and of the therapeutic action of drugs.

discovery which have made two centuries illustrious were born of a combination of emotion, intellect, and will-power which still lives in this University. We are not only the descendants of our forebears and the inheritors of the Greek legacy they bequeathed to us; we are also their spiritual partners and colleagues, sharing in the intellectual new birth which from time to time they experienced. Our problems are not different in principle or philosophy from theirs; they are different in degree. In the eighteenth century the mother school of Edinburgh stood alone in solitary grandeur; to-day her daughters at home and over the sea rise up and call her blessed. She rejoices that they have entered into the inheritance, an inheritance of knowledge and opportunity deeper and wider than her own. As one turns the matter over in one's mind, it would seem that the design of our forefathers was that the future of medical education as interpreted at Edinburgh should depend first upon an effective and living integration of the ancillary sciences of Medicine, and secondly upon sound clinical study.

Boerhaave taught chemistry, physiology, botany, and practice of physic; Monro *secundus* taught anatomy, surgery, and clinical medicine; Cullen first taught chemistry, then physiology, then practice of physic, then clinical medicine. Nowadays it cannot be done in that way; the burden of knowledge is too great. *But the crowning virtue and unity of their method must not be lost.* In a word, we must, whatever be the subject we teach, integrate with it, or into it, the essential sciences out of which it is constructed—the preliminary sciences into the anatomy and physiology; the anatomy and physiology into the pathology; and all of them into the clinical subjects.[1] It is a principle which should pervade the whole curriculum, but if there be one subject more than

[1] This has been recognized in this University by the institution of additional Chairs in biology and chemistry in relation to Medicine, in therapeutics, psychiatry, and applied bacteriology.

another which must be integrated every day, and into every subject, it is the master theme of biology. Every medical practitioner cannot be a physicist, but he must be a biologist, for that subject is the very heart and arterial system of Medicine.

Again, Lister, like Harvey before him, was an observer, then a philosopher, then an experimentalist. He was a giant in each capacity. But now *Experimental Medicine* is the growing point in all true medical education and research; it is indispensable to progress. The Greeks and the Arabs had fitfully sought *a posteriori* verification of their *a priori* hypotheses; but no one before Roger Bacon had recognized that not sporadic experiments, but the *experimental method* continuously applied, was the only universal way of research. His principle was induction towards deduction, in order to construct.[1] The school which does not seek to imbue all its students with the spirit of that method is dying or dead.

Once more we must, in the new time before us, cultivate *a social understanding* of the art of healing. One of the most instructive chapters in the growth of the Medical Faculty is that concerned with Medical Jurisprudence and Preventive Medicine. No medical school in Britain has behind it such a record as Edinburgh, and it cannot be doubted that the course here taken has contributed to what may be called the civic character of the Edinburgh graduate. Many of the early leaders possessed this social instinct: Laycock introduced Preventive Medicine into his lectures on the practice of physic; Lind and Pringle became practical exponents of it in the wider world; Christison gave Forensic Medicine its direction, and defined the public health purpose of 'medical police'[2]; Traill, the friend of Lord Brougham,

[1] 'Life and Work of Roger Bacon', by J. H. Bridges, 1914.

[2] For Christison's defence of this subject, see 'Commission on Universities of Scotland', 1826, Report, 1837, II. 320; also 'Life of Sir R. Christison', 1885 (2 vols.).

foresaw the need for hygiene in industry; Sir Douglas Maclagan and Sir Henry Littlejohn established within the University the growing relationship between Medicine and the State. The medical practitioner required in the present and future must be a citizen and a man of affairs as well as a doctor. He must indeed be a bearer of the lamp of science, but he must also be an understander of men and a student of the *social* conditions and needs of his time. Above all, he must appreciate the fact that his purpose is the *prevention* of disease, and the application of medical science to the safeguarding of an ever-widening commonwealth.

Thus the history of Edinburgh shows us that there must be (*a*) integration of the several sciences which are structural in Medicine, (*b*) the intimate application of the experimental method to all inductive study, and (*c*) a clear recognition of the prerogative part which Medicine may play in social evolution.

Of clinical study I have spoken elsewhere,[1] but in this University I may be permitted to recall the wise counsel of Dr. John Brown in his essay on Locke and Sydenham.[2] He urged, as Boerhaave urged, a return to the clinical habit of Hippocrates and Sydenham, and in an age of scientific laboratory methods and of instruments and tests of precision, such advice is even more necessary than of old. 'Our art is not to be better learned' wrote Sydenham to Dr. Mapletoft 'than by its exercise and use,' and in that exercise personal observation and experience should walk hand in hand with the advances of science, accepting new methods as supplementary servants rather than arbitrary masters. We have been the charmed witnesses of a golden age of medical science, *yet it is the medical art which endures*. The effective

[1] 'Recent Advances in Medical Education in England', 1923, pp. 65–101, and 'Thomas Sydenham, Reformer of English Medicine', 1924.

[2] 'Horae Subsecivae', 1858 (New Edition, 1900).

practice of that art depends, and must always depend, upon the clinical skill, wisdom, and experience of the individual practitioner. It is his own eyes and hands, his own observation and knowledge, his own understanding and resource, that alone can make him master of his art and lord of his event.

AN EPILOGUE

IX. The Greek Temple in Plain of Salerno

One spring morning we came down from Salerno and stood in the windswept parthenon of the great Temple of Poseidon, the God of the Sea, at Paestum. Round about us were those massive Doric columns in mysterious and solemn beauty; at our feet the green lizards darted across the sunlit temple floor, and all around were brambles and wild flowers, though it was yet too early for the twice-blossoming roses of Virgil (*biferi rosaria Paesti*). Beyond the plain the Apennines and the dark blue mountains of Cilento looked down upon us, on every side was the solitary wilderness of a long-forgotten world, and behind lay the calm waters of the Gulf of Salerno. The three Temples seemed to rise as a dream of sadness and of splendour out of the long past.

> 'Oh, they are Nature's own! and, as allied
> To the vast mountains and the eternal sea,
> They want no written history; theirs a voice
> For ever speaking to the heart of man.'

Yet 2,400 years ago the happy and prosperous Greek city of Posidonia was founded here, a brilliant colony of Magna Graecia, and this temple of sun and sea and wind was the shrine at its heart. Long afterwards came the invading hosts—Lucanian, Roman, Saracen, Angevin, corsair, barbarian—and the Greeks became strangers and

captives in their romantic home of exile. Once a year they held Hellenic festival, and, taking their harps from the willows, young men and maidens, old men and children, passed through this glorious colonnade chanting their hymn of inheritance and memory, and laying their laurels of devotion on the altar of their god. Now every habitation of that city has vanished; strife and disease have wiped out its people; the untilled lands are derelict and forlorn; the shrine alone remains, among the most pathetic and noble in all the world, in so great majesty. All things have changed through the centuries on that desolate shore, *nothing endures but the ideal.*

To-day we, heirs of their ideal, also celebrate our Hellenic festival; and our city, likewise, stands between the mountains and the sea. Our song also is of heritage and memory, though gladdened with fulfilled promise. For, alive together to-day, we pass through the ampler colonnades of a more glorious temple, not built with hands, this manifold, beautiful, and growing world; and, like the Greeks in the plains of Salerno long ago, we sing the ancient song of man's inheritance, of his healing gift and bodily endowment, of his creative and undying spirit, of his unconquerable mind.

APPENDIX

Year	History of Edinburgh Medical School	Year	Contemporary Dates
1505	Charter of Incorporation of Surgeons.		
		1518	Foundation of Royal College of Physicians, London.
		1543	' Fabrica ' of Vesalius published.
1580	Royal sanction for a College obtained.		
1582	James VI's Charter.		
1583	Opening of Town's College at Edinburgh.		
		1616	Death of Shakespeare.
		1628	Harvey, ' De Motu Cordis '.
		1642	Sir Thomas Browne, ' Religio Medici '.
1660	Sibbald at Leyden.		
1664	Surgeon-Apothecaries' Physic Garden established near High School Yards.		
		1666	Thomas Sydenham, ' Methodus Curandi '.
		1667	Milton, ' Paradise Lost '.
1670	Sibbald, Balfour, Pitcairne laid out Physic Garden, at Trinity Hospital.		
1676	Chair of Botany (Sutherland).		
1681	Foundation of College of Physicians.		
1685	Chair of Practice of Physic (Sibbald, Halkett, Pitcairne).		
		1687	Newton, ' Principia '.
		1690	Locke, ' Human Understanding '.
1692	John Monro at Leyden.		

	History of Edinburgh Medical School		*Contemporary Dates*
1693	Pitcairne returned from Professorship at Leyden.		
1697	Anatomical Theatre at College of Surgeons.		
		1699	Edinburgh Pharmacopoeia.
		1703	Principal Carstares (to 1715).
1705	Eliot taught anatomy, College of Surgeons.		
		1707	Parliamentary Union of England and Scotland.
1713	Chair of Chemistry (Craufurd).		
		1714	Boerhaave, Rector of Leyden and Professor of Medicine and Chemistry.
1718	Alexander Monro at Leyden.		
1720	Alexander Monro (primus) taught anatomy, College of Surgeons. Rutherford, St. Clare, Plummer, Innes joined Monro.		
1725	Monro moved to University.	1725	Allan Ramsay, ‘ Gentle Shepherd ’.
1726	*Foundation of Medical Faculty in University*. Chairs of Anatomy (Monro), Practice of Physic (Rutherford, Innes), Institutes of Medicine (St. Clare), Chemistry (Plummer), Midwifery (Gibson), Botany (Preston).	1726	Monro's Osteology. George Drummond, Lord Provost. Allan Ramsay at Luckenbooths.
1729	First teaching hospital in Robertson's Close.		
		1732	Philosophical Society founded, which became Royal Society of Edinburgh (1782).
		1734	Royal Medical Society initiated (founded 1737).
		1736	Linnaeus, ‘ Systema Naturae ’.
1738	Building of Royal Infirmary begun.	1738	Death of Boerhaave.

	History of Edinburgh Medical School		Contemporary Dates
		1739	Hume's Essays (History of England, 1761).
1741	Royal Infirmary opened.		
		1745	Jacobite Rising.
1748	Clinical teaching in Infirmary begun.		
		1749	Buffon, 'Histoire Naturelle'.
		1752	Pringle on Diseases of Army.
		1754	Black discovered CO (Latent Heat, 1761). 'Select Society' founded in Edinburgh.
1756	Cullen, Professor of Chemistry (Institutes of Medicine, 1766, Practice of Physic, 1773).		
		1757	British Empire in India.
			Haller's Physiology.
1758	Monro (secundus), Professor of Anatomy.		
		1759	Robertson, 'History of Scotland' (Principal, 1762–1793).
		1761	Morgagni, 'De Sedibus'. Auenbrugger (Percussion).
			Morgan, Shippen, and Rush of Philadelphia in Edinburgh (1761–1768).
		1763	North Bridge built.
			Reid, 'Enquiry into Human Mind'.
		1765	Foundation of Pennsylvania Medical School on Edinburgh model.
1766	Death of Lord Provost Drummond.		
	Gregory appointed to Chair of Practice of Physic.		

History of Edinburgh Medical School		Contemporary Dates	
1767	Chair of Natural History (Ramsay).		
1768	Chair of Materia Medica (Home). Eight Chairs now in Faculty.		
		1770	Hunter's School of Anatomy in London. Exceptional activity of Extra-mural School (Duncan, Bells, Barclay, etc.).
		1774	Fergusson's Poems.
		1776	Adam Smith, 'Wealth of Nations'.
1783	Cullen's 'First Lines' and 'Nosology' (1785).		
		1786	Robert Burns's first poems.
		1787	Desault and Corvisart (Clinical Teaching in Paris).
		1788	Gibbon, 'Decline and Fall of the Roman Empire'.
			John Peter Frank (1745–1821).
1789	New University Buildings in South Bridge.		
		1798	Jenner, 'Enquiry'.
			Bichat (1771–1802).
		1800	Sir H. Davy on nitrous gas anaesthesia.
		1801	John Bell's 'Principles of Surgery'.
		1802	*Edinburgh Review* (Jeffrey, Sydney Smith, Brougham).
1803	Chair of Clinical Surgery (Russell).		
		1805	*Edinburgh Medical Journal* founded.
		1805–1808	Scott's poems ('Last Minstrel', 'Marmion').

	History of Edinburgh Medical School		*Contemporary Dates*
1807	Chair of Medical Jurisprudence (Duncan).		
		1808	Roberton, ' Medical Police '.
		1814	' Waverley ' (Scott) ; Wordsworth, ' Excursion '.
		1815–1825.	Scott's novels.
		1819	Laennec.
1822	Christison, Professor of Medical Jurisprudence (Materia Medica, 1832–1877).		
		1825	Enlargement of compulsory Medical Curriculum.
		1828–1843	Dr. Chalmers, Professor of Divinity.
		1830	Anatomy Act.
1831	Chair of Surgery (Turner).		
	Chair of Pathology (Thomson).	1832	Death of Sir Walter Scott. Reform Bill.
1833	Syme, Professor of Clinical Surgery (to 1869).		
1836	Sir Charles Bell, Professor of Surgery.		
1840	Simpson, Professor of Midwifery (to 1870).		
		1843	Disruption of the Church of Scotland.
1846	Goodsir, Professor of Anatomy.	1846	Morton on Ether Anaesthesia.
1847	Simpson discovered anaesthetic power of chloroform.		
		1850	Death of Lord Jeffrey.
1853	Lister came to Edinburgh as Syme's assistant.		
1855	Lister's ' Early Stages of Inflammation ' and blood-coagulation (1858–1863).		
1858	Universities (Scotland) Act. Medical Act. Reorganization of University.	1858	General Council of Medical Education and Registration constituted.

History of Edinburgh Medical School		Contemporary Dates	
		1859	Darwin, ' Origin of Species '. Virchow. Sir David Brewster, Principal 1859–1868.
1867	Turner, Professor of Anatomy (to 1903). Principal 1903–1915.		
1869	Lister, Professor of Clinical Surgery. Development of antiseptic surgery.	1869	Medical Curriculum recommended by General Medical Council.
		1870	Education Act.
		1875	Public Health Act.
1879	New Royal Infirmary in Lauriston Place.		
		1882	Koch's bacillus of tuberculosis.
		1884	Tercentenary celebration. New buildings in Teviot Place.
		1890	Medical Curriculum amended.
1891	Maximum number of medical graduates 299 (1923, 351)		
		1895	Death of Louis Pasteur.
1898	Chair of Public Health (Stewart).		
1899	Schafer, Professor of Physiology.		
		1911	National Health Insurance Act.
		1912	Death of Lord Lister.
1913	Chair of Bacteriology (Ritchie).		
		1914–1918	European War.
1917	Chair of Tuberculosis (Philip).		
1919	Chairs of Chemistry in Medicine (Barger), Zoology (Ashworth), Therapeutics (Meakins), Psychiatry (Robertson).		
		1922	Revised Medical Curriculum of General Medical Council.

4. John Hunter

THE PRIVATE PRACTITIONER AS PIONEER IN PREVENTIVE MEDICINE

¶ *Being the Annual Oration of The Hunterian Society,* 1926. [*Reprinted by courtesy of The Oxford University Press, whose separate publication of this essay is still on sale.*]

THE PRIVATE PRACTITIONER AS PIONEER IN PREVENTIVE MEDICINE

The Background of Biology and Pathology

TWENTY years before the birth of John Hunter there were born two boys, one in Burgundy and one in Sweden, who were to live to transform man's knowledge of biology. Buffon, the son of a wealthy aristocrat, devoted his leisure to the compilation of an encyclopaedia of natural history. This famous book of fifteen volumes, issued between 1749 and 1767, gathered together the knowledge then available in the province of Nature. It has been described both as a monument and a grave. In any case, it is one of the chief landmarks in the history of biological learning. Moreover, Buffon raised questions which, though he did not answer them, set men's minds agog, for he was one of the first to believe in the mutability of species and the effect of environment upon them. Linnaeus, the Swede, was both a genius and a good workman. He studied medicine and botany at Upsala, Leyden, and in England, and when 29 years old produced with the encouragement of Boerhaave his great book, 'Systema Naturae', which forms the starting-point of modern biology. He brought to bear upon the accumulations of the past a critical faculty, a descriptive power, and a logical sense of classification which initiated the scientific movement of exact observation as the basis of differentiation of species in plants and animals. He handed his torch to his friends of the Jussieu family, to Cuvier the comparative anatomist, and to our own Erasmus Darwin, who by his first wife was the grandfather of Charles Darwin, and by his second of Francis Galton.

Here, then, is the mental background of natural history to the Hunterian period. It was a time of observation and classification. William Hunter's scientific godfathers and

teachers were Cullen and Monro primus, both of them naturalists, inspired by the wide and balanced apprehensions of Boerhaave, the expositor ; and William Hunter taught John Hunter. At the foundation of all John Hunter's work lay the deep broad basis of biology.

'Human anatomy was taking its place in his mind as but part of all anatomy,' says Mr. Paget ; 'he must know the whole animal world, every living structure in it ; must dissect everything, noting all different forms and arrangements of the organs, each method of Nature to adapt them to the necessities of life. . . . Hunter went forward from human anatomy to all anatomy and physiology, and from these to medicine and surgery ; from all of them together to profound study of life, alike in health and in disease, in all structures, at all stages. . . .' 'It was not' said Sir Everard Home 'his intention to make dissections of particular animals, but to institute an enquiry into the various organizations by which the functions of life are performed, that he might thereby acquire some knowledge of general principles.'[1]

His biological instinct followed two directions, the human body in health, the human body in disease. When John Hunter came to London at the invitation of his elder brother, Haller had been for ten years Professor of Biology, Anatomy, and Medicine—pregnant combination—in the University of Göttingen, a post to which he was appointed on the advice of Sir Hans Sloane by King George II of England, who was also Elector of Hanover. Haller is the supreme and predominant physiologist of the eighteenth century. Indeed, his 'Elementa Physiologicae' (1757) forms a dividing line between modern physiology and all that went before. We shall remember what went before. It was the discovery of the circulation

[1] 'John Hunter, Man of Science and Surgeon', by Stephen Paget, 1897.

of the blood by Harvey in 1616, the new physics of Descartes and Borelli, the capillary circulation of Malpighi, and the anatomy of the secreting glands. There was in that day, as in this, a new birth of Medicine. Harvey had opened the gates of the garden of physiology, and it was Haller who gathered the first-fruits of clinical application, particularly in relation to digestion, to nervous irritability, and to respiration. An understanding of the process of respiration and its relation to the nutrition of the body by the blood-stream was awaiting exact knowledge of the constitution of the air we breathe. Now in the same year as the publication of Haller's 'Elementa', Black, following Van Helmont, discovered carbonic acid gas; in 1772 Rutherford of Edinburgh discovered nitrogen; in 1774 Lavoisier, the brilliant French aristocrat who subsequently perished by the guillotine, following Priestley, recognized oxygen; and hydrogen was first made definite and clear by Cavendish in 1781. These four discoveries revolutionized man's knowledge of the physiological purpose of respiration. All this was happening in the spacious days of the Hunters, and it opened the book of physiology to the medical practitioner.

The practitioners were concerned after all with disease, and here too, in the understanding of the pathological aspect of biology, advance was being made in their day. For the long period of half a century the great Morgagni was professor at Padua. Like Sydenham he communicated his knowledge and discoveries, in the form of letters to his friends, on the sites and causes of disease (1761). This book of five volumes of seventy letters became the basis of modern pathology. In it he not only described many hitherto undefined morbid conditions, particularly diseases of the heart and circulation, but he made the gross anatomy the basis of his descriptions, and he related the conditions found *post mortem* with those in the living patient. Both anatomy and autopsy were

directed to the service of Medicine. This was a new orientation of pathology, which led the practitioner to think anatomically and pathologically in his clinical work, and to interpret signs and symptoms as the diseases developed. In after years Baillie and Bichat carried forward the enterprise.

The Coming of John Hunter

This in brief was the scientific atmosphere of the age into which John Hunter came, and to which he made his unique contribution. If we would understand the effect of the eighteenth century on modern Medicine, we must get this root-idea into our minds. First, the science of the period was characterized by a systematic view of natural history, and the art and science of Medicine were given a setting in the larger subject of Nature ; secondly, the meaning of physiology was being interpreted, and form was being related to function ; and thirdly, there was being instituted a search into the causes of disease and its varied manifestations. John Hunter, anatomist and surgeon, came as an explorer of genius into this field. Lacking the ordinary educational equipment of his brother William, he brought to bear upon his task untiring enthusiasm for knowledge and diligence in its pursuit, a penetrating power of observation and insight, and an inquisitive, experimental, and inductive mind. Hence it is not surprising that with the advent of John Hunter the purpose of practical medicine ceased to be an authoritative and empirical mode of treatment, and began to be viewed from the standpoint of Nature, of a living physiology and pathology. For Hunter was primarily, and in the true sense, a naturalist. He dissected, not only every day, but ' from the rising to the setting of the sun ', and described 500 different species of animal ; more than that, he watched Nature at work, and standardized his deductions by her plumb-line. As a physiologist he

held that the blood, a living fluid, was the basis of nutrition, that structure is the ultimate expression of function, that embryology bespeaks a unity throughout Nature, that the function of the lower animal is a simpler form of the higher, and that both forms and function must be studied on a comparative basis all through the living world. In pathology it is the same. To him abnormality is an aberrant or arrested growth, and disease a process and not an entity, against which the body reacts by the restorative defences of its own tissues. Thus in his work as a practitioner he was first an exact clinical student, though without instruments of precision; then a careful observer, then a rationalist. As an explorer he was a collector (of 13,000 specimens), then an observer and experimentalist, then again a rationalist. Having acquired few prejudices, he thought biologically, and without elaborate doctrine; his principle of treatment was a reliance on the recuperative forces of Nature. All this lay athwart the medical learning of his day, and brought him into collision with others. But because of his first-hand knowledge and his genial human spirit he became a great teacher, and his pupils carried his legacy into all departments of medicine and surgery, and not least into the ever-expanding realm of Preventive Medicine. For, if we will but think about it, the foundations of Preventive Medicine are an understanding of and a reliance upon the laws of Nature, as they concern all forms and conditions of life; an appreciation of the capacity of the physiological functioning of the human body and its inherent powers of repair; and a knowledge of the cause and circumstance of disease. Not as an anatomist nor yet as a surgeon, but as a naturalist who was a co-ordinator and explorer of the unity of the human body, John Hunter must rank as one of the fathers and founders of modern Preventive Medicine.

The eighteenth century was the beginning of Preventive Medicine, not because it was characterized by a high

standard either of sanitation or of personal or communal health—for this was not the case—but because it was a time when physiology and pathology first began to be integrated with clinical medicine and surgery, when a conception of laws in health and disease took the place of fate or empiricism, and when the aspects of infectious disease in the aggregate, that is epidemic disease, were more closely studied in a spirit of scientific curiosity by more medical practitioners than at any previous time in our history. They became, perhaps half-unconsciously, the successors of Thomas Sydenham as he himself followed Hippocrates. Men began dimly to see Preventive Medicine, not as a small by-product of Medicine dealing with 'drains and stinks', but the primary business of all medicine, and concerned not only with disease, but with the physiological capacity and building up of the human species. We have not always retained this vision, but this in fact was the vision of the forward-looking minds of the eighteenth century. It was part of the imagination and adventure of the critical, rationalist, and inventive spirit, yes, and of the larger sympathy of man with man, which in all departments of human endeavour made the eighteenth century 'the great heroic age of England'.

The Channels of his Influence

The influence of John Hunter in this situation was pervasive and cumulative rather than direct and decisive. Nevertheless, immediately he accomplished three great things. First, he demonstrated rather than introduced the place of morbid and comparative anatomy in all clinical work. Morgagni systematized, but Hunter made actual and routine the practice of anatomical and pathological thinking. Secondly, not being a bookman himself, he impressed his generation with the necessity of personal observation and experiment. 'Did you go yourself and

examine this, or how do you *know*?' asks Socrates of Glaucon. It is of the very essence of scientific enquiry. Hunter seems to say to the practitioner of his day: 'Go and look for yourself; don't theorize but try; observe *closely*, collect your facts, then draw your deduction'. He was listened to at once only by his own pupils and surgical contemporaries, but his influence steadily spread to the whole profession. Nor was he alone. Other leaders in the eighteenth century were saying the same thing before and after him, but he said it and did it with greater perseverance and emphasis and on a larger scale. Writing to Dr. Staunton in 1762, Johnson said, 'Trust as little as you can to report; examine all you can by your own senses.' Thirdly, Hunter was not only a student of Nature's ways, but he accepted Nature's forces in his practice. There was a widespread intellectual return to natural science in his time, but he practised natural *art* in his reliance on the recuperative powers of the human body in his treatment of disease. Thus he became, as Sir Arthur Keith has shown, one of the founders of modern orthopaedics.

These were the things he did directly in his productive period from 1760 to 1793. But his fourth great contribution, perhaps the greatest of all, was his legacy to his pupils, who became the leaders of the next generation.

Hewson of Hexham came to the Hunters' school in 1759, and when John went abroad in 1760 he was left in charge, subsequently becoming a partner with William. He continued the physiological research then begun, and discovered the lymphatic system of birds, reptiles, and fishes, and exploring the properties of the blood established the fact that coagulation depended on the creation of a 'coagulable lymph' in the plasma.

Cruikshank, described by Johnson as 'a sweet-blooded man', succeeded Hewson as William Hunter's assistant, and carried on the school after William's death, in conjunction with Matthew Baillie. He investigated the

repair of divided nerves, the physiology of absorption, and the excretory power of the skin. Subsequently he was one of the founders of the dispensary system. Upon Baillie, the nephew of the Hunters, who joined their school in 1779, fell their mantle of pathology. He was not only, like them, a great dissector and morbid anatomist, but he transmitted their views in his own classic text-book which was in universal circulation for two generations. He was also a great practitioner and one of the founders of modern medical education.[1]

Then there were the pupils who carried on the surgical tradition of John Hunter—Cline at St. Thomas's, Sir William Blizard at the London, Sir Astley Cooper at Guy's, Abernethy at St. Bart.'s, Hey at Leeds, White at Manchester, and Physick, who carried the torch of surgery to Pennsylvania in 1794. But William Shippen and John Morgan, who came here for their studies, had already taken back the ideas and teaching of the Hunters to the same city, and became the founders of the Medical School in Pennsylvania.[2] Lastly, two of the most remarkable men who have ever adorned the profession of Medicine, Thomas Young and Edward Jenner, both learned at the feet of John Hunter in Windmill Street, and whilst the discoveries accredited to them were not

[1] 'The Works of Matthew Baillie', by T. Wardrop, 1825.

[2] Apart from the establishment of a Chair in Medicine at the University of Mexico at the end of the sixteenth century, the Medical School attached to the University of Pennsylvania was the first university medical school in the United States of America. It was initiated in 1751 by Dr. Thomas Bond, with the aid of Benjamin Franklin. When Bond studied in England he knew Fothergill, who also helped Shippen on his return to America in 1762. Shippen used Fothergill's anatomical diagrams in his first course of lectures. Morgan, another American student in England, returned to Philadelphia in 1765 and Rush in 1769. In their construction of Medical Schools, these four pioneers followed the Edinburgh model and the teaching they had received from Fothergill and the Hunters. (See 'Dr. John Fothergill and his Friends', by R. H. Fox, 1919, p. 366.)

directly due to Hunter's initiation, their inspiration was his own.[1]

The Bills of Mortality

The first half of the eighteenth century is often described by the historian as one of exceptional national prosperity. With certain exceptions, there were abundant harvests, low prices, and large exports of corn. The people lived in the villages on 'sustenance agriculture', and London and Bristol were the two largest towns. Men bowed and scraped punctiliously over their snuff-boxes; the philosophers droned tediously in their formal gardens; the wigs and the music were alike precise. Yet it was a time of national expansion, of commercial success, and of cheap living for the masses of the people. As we learn from the novels of Fielding and Richardson, the middle classes were comfortable and complacent; and Hallam and Lecky join in declaring that the times were 'the most prosperous England had ever experienced'. Pope's lyric was designed to sing rather than to read—

'Where'er you walk, cool gales shall fan the glade,
Trees where you sit shall crowd into a shade;
Where'er you tread, the blushing flowers shall rise,
And all things flourish where you turn your eyes'—

and Hogarth, Reynolds, and Gainsborough prove that the century was not blind to colour and design. Nevertheless, the period had its unwholesome aspect. The health of London was never worse, nor was the country as a whole much better. Typhus, small-pox, and malignant scarlet fever abounded. The following table gives the death-rates of the period as compared with the last half century.[2]

[1] See also 'Memoir of William and John Hunter', by G. C. Peachey, 1924.

[2] 'Health of London in the Eighteenth Century', 'Proc. Royal Society of Medicine', Vol. XVIII, No. 11, September, 1925, p. 74.

Mortality rates in the eighteenth century
Crude death-rates per 1,000.[1]

	London	*England*
1701–10	29.4	28.6
1711–20	32.8	31.1
1721–30	37.8	34.9
1731–40	36.2	35.8
1741–50	34.7	33.0
1751–60	28.2	30.3
1761–70	32.0	30.3
1771–80	29.5	31.1
1781–90	26.4	28.6
1791–1800	26.9	26.9
		England and Wales
1871–80	22.4	21.3
1881–90	20.3	19.1
1891–1900	19.2	18.2
1901–10	15.8	15.4
1911–20	14.9[1]	14.3[1]

The figures speak for themselves, but it must be said that the high mortality of 1721–1750 was due not to pestilence so much as the social habits of the people, the immigration into London, and particularly to alcoholic excess. The expectation of life at twenty years of age was fifteen years less than at present. Again, child-birth was a risky proceeding for mother and infant. The maternal death-rate before the establishment of lying-in institutions (from 1740 onwards) was extremely high. Things were much improved thereafter, but even the mortality in the institutions reached 1 in 42 (1749), though it fell in fifty years to 1 in 914 lying-in women admitted. The children fared even worse. The Bills of Mortality of the period as compared with the last decennium (1915–1924) are detailed on p. 125. Thus it will be seen that it was not until after 1770 that the general and infant mortality began to decline. The black period was from 1720 to

[1] Including war years, figures approximate only.

1770. Gainsborough painted delectable pictures of pretty children, yet at his zenith 50 per cent of all the children died before they were five years old.

Births and Deaths under five years of age, according to the London Bills of Mortality, for 100 *years in five periods of* 20 *years each, and the number dying under five years out of* 100 *born.*[1]

	1730–49	1750–69	1770–89	1790–1809	1810–29	1915–24
Total Births	315,456	307,395	349,477	386,393	477,910	927,473
Total Deaths under 5 years	235,087	193,694	180,058	159,571	151,794	128,739
Dying per cent under 5 years	74.5	63.0	51.5	41.3	31.8	13.8

Main Currents of Preventive Medicine in the Eighteenth Century

(i) *Exploration and Prevention of Epidemic Disease*

I now turn to consider briefly the main currents of Preventive Medicine as they showed themselves in the Hunterian period. And the first and most obvious is that concerned with the exploration and prevention of epidemic disease. After 1666, plague, though incidental and sporadic, no longer swept the country as it had done for three centuries before 1665. Dr. Richard Mead's famous 'Short Discourse concerning Pestilential Contagion' appeared in 1720. It was written at the request of 'the lords of the regency' on the occasion of the outbreak of plague at Marseilles in 1719, the infection of

[1] 'Vital Statistics', by W. Farr, 1885, p. 195. See also 'Proc. of Royal Society of Medicine', September, 1925, pp. 73–84 (Brownlee); 'London Life in the Eighteenth Century', by M. Dorothy George, 1925.

which it was feared would spread to England. So disturbed was public opinion that seven editions appeared in one year. The book is of historical interest as the first report of epidemiology produced by a medical practitioner at the bidding of the State. The Discourse discussed the origin and nature of the plague, the causes of its spread (alleged to be diseased persons, infected goods, and a corrupt state of the atmosphere), and the measures to be taken against it. Mead recommended the appointment of a Council of Health with plenary powers, of 'searchers' for the dead, and of 'skilled physicians' to attend the sick. He advocated certification of affected persons, the prompt isolation of the sick, and the disinfection of both persons and houses. The expenses of carrying out his methods were to be chargeable on the public. He cited Ferrara in Italy as a town where such measures had proved successful in 1630, as also in Rome in 1657. Even at Poole in Dorset the plague had been stayed in this way. 'The principal management of this whole affair' says Mead 'consisteth in two things: (i) in separating the sick from the sound; and (ii) in cleaning well the houses which had been infected.'[1] As it happened, there was no occasion for putting into force Mead's proposals, as the plague did not reach England in epidemic form.

The diseases which tested the skill of medical practice in the eighteenth century were small-pox, influenza, puerperal sepsis, scarlet fever, and typhus fever. First, they had to be diagnosed and differentiated, and secondly, they had to be treated or prevented. At no period in English Medicine has there been such a bold and significant attack upon epidemic disease by the medical practitioner as that which characterizes the eighteenth century. From 1720 onwards, we have an astounding record of the pioneering efforts of practitioners to study and understand and grapple with these diseases. There

[1] 'A Discourse on the Plague', 1720.

lie before me as I write references to upwards of 150 private practitioners, excluding medical men in the services, who investigated epidemic diseases in England within the Hunterian period. The best epidemiologists of the time were not in London, but at Plymouth, Chester, Manchester, Newcastle, York, Ripon, Halifax, Kidderminster, Dublin, and Cork, and it is not surprising to find that the result was the establishment for the first time of some of the principles of epidemiology and the prevention of disease which are now of common knowledge and acceptance. ' Never think it clever ' said Johnson ' to call physic a mean study.'

Let me choose one or two examples. There was practising in Chester from 1767 to 1793 a highly observant medical man named John Haygarth. He was born there in 1740, and after being educated at Edinburgh he returned to practise in his native city. In 1798 he retired to Bath, and there he died twenty-nine years later. Several years after starting practice he began his epidemiological enquiries into small-pox and typhus, and an enumeration of the inhabitants of Chester in order to check the incidence and progress of disease, and to introduce a system of notification. His description of typhus fever was one of the first and most reliable, and this led him to formulate the nature and conditions of febrile infections. He took two villages for comparative purposes and made observations upon differential symptoms, proportions of population infected and insusceptible, the channels, dosage, and conditions of infection, effect of ventilation and uncleanliness, distance over which infection is carried, and above all the length of the ' latent ', or, as we now call it, incubation period. Upon these data he established the necessity for isolation (1775) and drafted rules for the institution and conduct of fever hospitals. Thus Haygarth, the medical practitioner of Chester, was one of the first to distinguish different kinds of fever by their periods of incubation, and to suggest their notification,

and he was the first to insist on isolation, a practice begun at Chester in 1783, and followed at Manchester in 1796, and subsequently at Liverpool, Edinburgh, Newcastle, Dublin, and other towns, in the institution of what were then described as Houses of Recovery.[1] Haygarth also made a valuable study of acute rheumatism, and described rheumatic nodules in 1780.[2]

I have mentioned Haygarth as a type of the group of eighteenth-century practitioners who, combining their clinical work with communal health, allowed their conceptions of the latter to grow out of their observation of their patients. He was not in point of time the first of his group. Before him there had been Huxham, Heberden the elder, and Fothergill; his contemporaries were Percival, Withering, and Lettsom; and after him came Willan and Parry. Heberden was described by Dr. Johnson as 'the last of the great physicians', and indeed his distinguished bearing, his sweetness of manners, and his deep sense of religion raised him to an uncommon height in public and professional esteem. He was an accomplished Greek and Hebrew scholar and a great note-taker, leaving behind him exceptionally valuable commentaries on chicken-pox, measles, night-blindness, 'epidemical cold', the pulse, and angina pectoris. From the clinical notes of a lifetime, he produced his great commentaries on the 'History and Cure of Disease', published after his death in 1801 at the age of ninety. Sir Norman Moore said Heberden owed nothing to books, but everything to his own observation of disease in the living patient, and this without any of the modern instruments of precision. Heberden agreed with Cullen that there are more false facts in Medicine than false theories, and he set himself to check and record facts as he found them during a length, extent, and variety of opportunity

[1] 'Letter to Dr. Percival on the Prevention of Infectious Fevers', by J. Haygarth, M.D., F.R.S., 1801.

[2] 'A Clinical History of Acute Rheumatism'.

rarely given to any man. Fothergill's practice was also exceptionally large, like his circle of friends ; and out of both was born the wide influence which he exercised upon his day and generation in this country and in America.[1] His study of epidemic sore throat in 1747, a form of malignant scarlet fever, is the scientific work for which he is best known ; but he also wrote many short papers embodying his observations on disease met with in his practice, including the uses of drugs, sciatica, tuberculous meningitis, hydrophobia, epilepsy, megrim, phthisis, pigment poisoning, and influenza. He was a botanist, a meteorologist, and a philanthropist, and related all these subjects to his study of disease. Diet, fresh air, and exercise were leading features in his treatment. He gave a second place to bleeding, purging, and blistering, and relied upon the stimulation of vital processes and resistance of Nature. ' How many lives were lost ' wrote Withering in 1793 ' until Dr. Fothergill taught us to withhold the lancet and the purge.' Like Fothergill, Withering of Shropshire and afterwards Birmingham was a botanist who studied scarlet fever and tuberculosis. He also made analyses of waters, was a climatologist, and introduced digitalis. His ' Account of the Foxglove ' is a pharmacological classic. These four men illustrate the clinical epidemiologist of the period—observant, proceeding by induction, seeking always the way of prevention.

(ii) *Lead Colic and Scurvy*

But infectious disease was but one field of exploration. At the beginning of the eighteenth century the dominant figure in European Medicine was Boerhaave of Leyden, who, though not himself a great investigator, urged others on in the path. One of his principal subjects was the physiology of digestion, which a generation later was taken up by Haller and subsequently by Spallanzani. Whilst

[1] ' Dr. John Fothergill and his Friends ', by R. H. Fox, 1919.

these three physiologists were endeavouring to decide between the mechanical theory of digestion as against the chemical, the practical-minded English practitioner was tackling alimentary problems as and when they arose. In 1692 there was born at Totnes in Devonshire John Huxham, son of a local tradesman. In early life he displayed a strong bent to medical study, and in due course was sent to Leyden to be a pupil of Boerhaave. On his return home, he settled in practice at Plymouth and began at once to carry out the teaching he had received. This meant observation of the body and its fevers, and of all that affected them, weather and the influence of season included, as Boerhaave had taught him. He kept meteorological registers for thirty years and voluminous records of the epidemic seasonal fevers with which he met in practice.[1] His books had a wide circulation and were translated into French and German, and his influence in England in the early part of the century was unique.

'Huxham neglected no efforts which he thought might conduce to his professional advancement, and believing that the appearance of being extensively sought for and employed was one of the most certain means of actually becoming so, descended to expedients which his better judgment could not have approved. He would, it is said, go to chapel, order his servant to call him out in haste—when he was not really wanted—get upon his horse, and ride furiously out of one gate of the town and in at another. He affected great gravity, dignity of manner, and peculiarity of dress, and wore, as his ordinary costume, a scarlet coat with ruffles at the wrist, and a cocked hat.'[2]

'A realistic presentment recalls his figure, as, conspicuous in a scarlet cloak, flowing wig and velvet dress, ruffled shirt and golden snuff-box, he moved with affected

[1] 'Essay on Fevers', 1739 ; 'De Morbo Colico', 1752 ; and 'Malignant Ulcerous Sore Throat', 1757.

[2] 'Biographia Medica Devoniensis', by William Munk, M.D.

strut and simulated gravity from house to house ; or was carried in his sedan chair, with link-boys in attendance, when the nights were dreary. No one was more conscious of these elaborate impositions than Huxham himself, and he confessed that, although he laughed when he indulged in them, they largely contributed to his prosperity.'[1]

'Although he had several competitors in Plymouth of character and attainments more than respectable, none were able to compete with him in energy and assiduity—none in extent of professional knowledge, or in the tact with which he applied it to the recognition and alleviation of disease. His aptitude in seizing on the really important points of a case, and felicity in the selection of means wherewith to meet them, are points in his professional character which, handed down by tradition, are abundantly exemplified in his writings.

'Mr. Pettigrew has justly remarked that Huxham "is one of the few physicians who has chosen nature for his guide, and by attentive observation viewed the various phenomena of disease and treated it on philosophical principles". Plain good sense, minute and careful observation, and cautious induction, characterize all Huxham's writings.' (Munk.)

One of the subjects which arrested his attention was the seasonal colic and palsy which was suffered by his patients who drank the Devonshire cider. In the winter of 1724–1725 Huxham found it so common 'that there was scarce a family amongst the lower rank of people that had it not', and he sometimes saw five or six persons lying ill of it in one house. He was the first to describe this condition in 1739, though he did not know the cause of it. A similar malady was observed by Cadwaladr in 1745 in the West Indies in drinkers of rum distilled through leaden pipes, and in 1757 by Tronchin, the talented physician

[1] Whitfield's 'Plymouth in Times of War and Peace', 1900.

of Geneva, in drinkers of lead-sweetened wine. Ten years later this mystery was cleared up by Dr. (afterwards Sir) George Baker, a near neighbour of Huxham in Devonshire, though he did not practise there, who rose to become President of the College of Physicians. His 'Essay concerning the Cause of the Endemical Colic of Devonshire' showed that the disease was connected with large pieces of lead used in the vats and cider-presses, and he extracted lead from the cider itself. His work, though it concerned a small and circumscribed problem, was so logical, accurate, and inductive, that it afforded a new method of investigation into the contamination of food supplies, which has been pursued by innumerable workers ever since. It opened a new chapter in the book of Preventive Medicine.

Another disease which arrested Huxham's attention, as it had medical observers before the eighteenth century, was *scurvy*, and in 1747 he recommended that the sailors who were disabled by this malady, which was not only exceedingly rife but very disabling and fatal, decimating fleet after fleet, particularly in Lord Anson's Expedition to the South Seas in 1740, should be fed regularly on a vegetable diet and a pint of cider a day. Dr. Mead recommended the same course in 1749, and he was always for fresh air and hygiene. 'Dr. Mead lived more in the broad sunshine of life' said Johnson 'than almost any man', a pleasant ideal for us all. Three years later the scurvy of seamen was described and investigated by Dr. James Lind of Edinburgh (and afterwards of Haslar), who found that the disease was due, not as had been alleged to drinking sea-water or living in 'putrid air', but to certain dietetic deficiencies, particularly to the lack of fresh water and vegetables and greens, and an excess of salted meat. He revived an old recommendation that oranges and lemons should be used, and he described a method for preserving lemon-juice for long voyages.[1]

[1] 'On the Scurvy', 1752.

Many years afterwards the use of lemon-juice and the adoption of personal hygiene by Captain Cook in his voyage round the world, by Admiral Wager in the Mediterranean, and by Sir Gilbert Blane in Lord Rodney's fleet, abolished this immemorial disease from the mercantile marine and the British navy. Nor was the navy alone the object of improved hygiene, for in 1752 there was published Sir John Pringle's classic work on 'Diseases of the Army', which exerted an enormous influence on the progress of Preventive Medicine generally.[1] Both these medical officers, the one at Haslar and the other physician with the army, became illustrious as exponents of Preventive Medicine. Never before or since had the civil population learned so much essential hygiene from the services. Pringle's recommendations for soldiers abroad found abundant application at home; and Lind wrote on fevers and the prevention of infection (1761), on tropical medicine (1768), and on the health of seamen (1774). Sir John Pringle was not quite an ordinary medical practitioner. A pupil of Boerhaave, he became Physician-General to the British Army in Flanders and elsewhere (1742–1749), and out of his varied experience became one of the greatest exponents of hygiene of his time. Similarly, Willan, Prout, and Wells, instead of becoming private practitioners, devoted themselves to special scientific studies. Willan differentiated skin diseases, Prout worked at the chemistry of gravel, stone, and body metabolism, and Wells studied the cause of the formation of dew.

(iii) *Health in the Factory*

The industrial development of England towards the end of the eighteenth century led to the employment of large numbers of children sent for the purpose by the

[1] The greatest text-book on hygiene in this period was the 'System of Medical Polity', by Johann Peter Frank, the Bavarian, published at Vienna in 1777–1788 (4 vols.).

Poor Law authorities from agricultural to industrial districts. The unsatisfactory physical and social conditions of these parish 'apprentice' children soon became a subject of public concern. Compassion for the chimney-climbing boys began soon after the middle of the century, but it was later that the children came to the cotton mills. The stronger children were kept for home labour, the weaker and younger were sent in batches to the northern and midland factories. In 1795 Dr. Aikin gave an account of such batches of London children who had been despatched for a number of years to the cotton mills in Manchester. He described their separation from their parents, their long hours of work under insanitary conditions, and the sickness and invalidity which resulted. But, a few years before this date, there was an outbreak of fever in certain mills in the Manchester district, and the magistrates called for a medical committee to investigate the matter, among the members of which were two practitioners, Dr. Thomas Percival, F.R.S., and Dr. John Ferriar, the literary author of 'Medical Histories and Reflections'. That was the beginning of a far-reaching national medical service. They found excessive hours of labour, unwholesome conditions, and insanitation fostering the spread of infectious disease. They found young children enslaved in a system which was directly harmful to body and mind. These facts were brought before a voluntary Board of Health which they and their friends had devised in 1796, with the result that the question of factory hygiene and regulation by law was brought to the attention both of the authorities in Manchester and the Imperial Parliament in London. Some years afterwards Sir Robert Peel acknowledged his indebtedness to Percival and his associates in the preparation of the Health and Morals of Apprentices Act of 1802, the first of that great stream of factory laws, the influence of which has revolutionized health in industry throughout the world.

Percival was the accomplished friend and correspondent of Haygarth of Chester, and both of them were friends of Fothergill, with whom they used to discuss their clinical and epidemiological problems when he came north for his summer holiday to Lea Hall in Cheshire. Born at Warrington in 1740, Percival settled in Manchester in 1767, where he had a large practice and was physician to the Infirmary. He wrote on hospital regulation, medical ethics, bills of mortality, and small-pox and measles. In 1770–1773, being a mathematician, he occupied what leisure he could secure in devising methods for the enumeration of the population, and for accurate death returns and disease incidence. He was one of the founders and President of the Literary and Philosophical Society of Manchester, the fever hospital, and the Board of Health. He was the friend of De Quincey, Voltaire, Diderot, and Condorcet, an acute and scientific observer and a strong believer in the preventive aspects of Medicine. He had the same human message to deliver as John Howard, the English prison reformer, and the Prussian chaplain Süssmilch in his ' Divine Order ' of 1742—that the greatness of a nation depends not only upon material and financial resources, but upon an industrious, healthy, native population, justly dealt with through good and evil. He was the leader of that long line of medical practitioners who, in the nineteenth century, saved the health of the factory worker.

Closely akin to this reform is that of sanitation and housing, of which, indeed, there is little to say. The old street and cleansing enactments of the fourteenth and fifteenth centuries were continued and revised. Something of a new era began with certain Improvement and Paving Acts, but the slums and rookeries of London were not dealt with seriously by the State until the nineteenth century. Insanitation, miserable housing accommodation, indifferent water-supply, window taxation, and similar disadvantages abounded. Cleanliness, ventilation, and

better food did most, in Dr. Heberden's opinion, to improve the public health, though Sir Gilbert Blane would also have attributed some credit to sanitation.

(iv) *Spirit-drinking*

Whilst the general standard of living in England improved in the first twenty years of the eighteenth century, there was a serious set-back between 1720 and 1750, during which period the number of deaths greatly exceeded the births. This has been attributed to the orgy of spirit-drinking which characterized the period. Gin became in fact 'the real grand destroyer'. Distilling was a new trade in England, and as it provided a revenue for the State and at the same time gave the farmer a favourable market for cereals, it received widespread support from the landed interest, from the distiller and retailer, and from the consumer. Accordingly, Parliament itself promoted the production and consumption of spirits. In a few years the results became so disastrous that the College of Physicians and numerous grand juries and sessions petitioned Parliament to impose restrictions. The number of pot-houses increased to such an extent that there was one to every six houses and every forty-seven persons. Maitland says that 'the excessive drinking of spirituous liquors has so enervated the stomachs of the populace as to render them incapable of performing the offices of digestion, whereby the appetite is so much depraved that its inclination to food is much lessened and the consumption of provisions greatly diminished'.[1] In 1750, London physicians directly attributed 14,000 cases of illness in the Metropolis to the excessive drinking of gin. Hogarth illustrated the results in his representation of 'Gin Lane', and Smollett said that 'such a shameful degree of profligacy prevailed that the retailers of this poisonous compound (gin) set up painted boards in public inviting

[1] 'History of London'.

people to be drunk for the small expense of one penny, assuring them they might be dead drunk for twopence, and have straw for nothing; they accordingly provided cellars and places strewn with straw, to which they conveyed those wretches who were overwhelmed with intoxication; in these dismal caverns they lay until they had recovered some use of their faculties, and then they had recourse to the same mischievous potion.'[1]

Scarisbrick, the Inland Revenue officer, writing of this period says that 'drunkenness abounded. By 1720 we had become a nation of tipplers. The nobility patronized brandy, the well-to-do middle classes drank a newly-introduced spirit called rum; the working-classes imbibed a characteristic spirit known as British gin. The consumption of gin was enormous.' When certain restrictions which had been temporarily imposed were repealed in 1733, he says, 'England touched a lower depth of inebriety than ever known before or seen since. The prevailing intemperance was the most momentous event of the eighteenth century.'[2]

With a view to meeting the problem thus created, Parliament passed a series of Gin Acts. In 1736 it imposed a high duty on spirits and a high fee on licences. Though at first this effected some reduction, things soon became worse than before, and maximum sale and consumption occurred about 1743. After various abortive measures, the Acts of 1751 and 1752 took effect. They aimed at the suppression of gin-shops and private retail sales.[3] Lecky held that these measures were efficacious, but even at the end of the century Dr. Willan wrote that 'on comparing my

[1] 'History of England', ch. xviii.

[2] 'Spirit Manual, Historical and Technical', by J. Scarisbrick, Burton-on-Trent, 1891, pp. 39–40.

[3] 'History of Liquor Licensing in England', 1700–1830, by S. and B. Webb, 1903; and 'London Life in the Eighteenth Century', by M. D. George.

own observations with the Bills of Mortality, I am convinced that considerably more than one-eighth of all the deaths that take place in persons above twenty years old, happen prematurely through excess in spirit-drinking '.[1] In addition to legislative action, the scientific evidence against the excessive consumption of alcohol was presented by Dr. Cadogan, Dr. Trotter, and other medical men, and the public-spirited action of Wilberforce and his friends created a more enlightened opinion and healthier habits among the people. Dr. Cadogan's book on gout is perhaps the most remarkable preventive treatise on the evils of intemperance that appeared in the eighteenth century.[2] It passed through ten editions in two years.

(v) *Midwifery*

In 1741, when William Hunter came to London, he stayed at the apothecary's shop of William Smellie in Pall Mall. Like himself, William Smellie was an active young Scotsman from Lanarkshire, who, after wandering on the Continent, devoted himself to obstetric practice in London, where he soon filled a pre-eminent position. He was the friend and teacher of Tobias Smollett, learned his midwifery in Paris, and settled in London in 1739 as practitioner and teacher. His famous text-book of three volumes was one of the stable foundations of the science and art of midwifery. Indeed, modern midwifery in this country may be said to have begun with him. For he did two great things. In an age of woman midwifery, he led the case in favour of the man obstetrician, and he introduced new methods—for the pelvimetry of contracted and normal pelves, for the safe use of the forceps, for the diagnosis and treatment of placenta praevia, and for improved modes of version. He was rather an uncouth

[1] ' Report on Diseases in London ', 1801.

[2] ' A Dissertation on the Gout and all Chronic Diseases ', 1771.

person, and on that account never acquired a large practice among the upper classes, but his knowledge, skill, and teaching powers placed him easily in the forefront, and he did more than any other individual to advance obstetrics in the eighteenth century. ' No real improvement in the art of midwifery could occur ' says Dr. Fairbairn ' till medical men had the opportunity of studying natural or physiological labour, instead of being called in merely when some extensive or mutilating operation was required. Hence the rise of the man-midwife marks a very important stage in the history of obstetrics.' This was accomplished, amid much opposition, by Smellie, who, not content to be himself a man-midwife, set about the business of educating 900 others. He introduced the plan of extern districts for men students to gain experience in midwifery.

Two remarkable men followed Smellie, William Hunter and Charles White of Manchester. William Hunter was primarily an anatomist. He was a dissector and a follower of the body rather than the book ; he added knowledge of the anatomy of the testes, the lachrymal glands, the lymph vessels, congenital hernia, varicose aneurysm, the foetal circulation of the placenta, and the gravid uterus ; he founded a school of anatomy in which were bred some of the masters of Medicine ; and he taught John Hunter. ' If it had not been for William, we never could have had John.' When teaching anatomy, William Hunter practised as a surgeon, but later on, when he took his physician's degree, he practised mainly as an obstetrician. But in truth nothing that came within his medical scope was foreign to his mind. For many years he was the acknowledged leader in midwifery in London. His practice was conservative, and he discouraged the use of the forceps, yet more than anyone of his time, by his skill, his anatomical knowledge, and his urbane and conciliatory manner, he commended the employment of the man-midwife, and thus

contributed to Preventive Medicine. For wise, careful, and sound midwifery is Preventive Medicine in being.

Charles White, F.R.S., was a pupil of the Hunters. He was born in 1728, and after studying in London and Edinburgh, became one of the founders of the Manchester Infirmary and medical school. Though he began as a surgeon and did valuable work in regard to the preventive surgery of fractures, dislocations, and haemorrhage, his genius found its fullest expression in his epoch-making treatise 'On the Management of Pregnant and Lying-in Women and the means of curing, but more especially of preventing, the principal disorders to which they are liable', published in 1773.

In this wonderful little book, White dealt with the general management and hygiene of child-birth, and the cause and prevention of puerperal fever. He argued that domestic insanitation exerted a direct effect in favour of sepsis, and hence he advocated 'maternity homes'; and that as in the early months of pregnancy there were personal factors at work which proved mischievous to healthy delivery, he recommended systematic ante-natal supervision. He claimed that it was retained and putrefying lochia which generated the puerperal sepsis that carried off so many patients. 'The danger does not arise from the smallness of the quantity of the discharge' he says 'but from its stagnation, whereby it becomes putrid, and in this state is absorbed into the circulation.' After giving a full account of the signs and symptoms of puerperal fever, he offers suggestions for its prevention. These consist mainly of (*a*) cleanliness of the patient, her bedding, clothing, and surroundings; (*b*) the early adoption of the sitting-up position after delivery; (*c*) the dietary; (*d*) fresh air and suitable temperature of the lying-in ward; and (*e*) disinfection. By his method of dealing with the lying-in woman, he claimed that he had never lost a case by puerperal fever. He attributed

puerperal sepsis to 'effects of mismanagement in the accoucheur or nurses, or else arises from the patient's own imprudence'.

Owing to the high death-rate among lying-in women, Sir R. Manningham had, as early as 1739, advocated the establishment of a special lying-in hospital in connection with the Westminster Workhouse, and in the next ten or twenty years several similar and larger institutions were opened separately, or in association with the general hospitals. In 1790 White followed suit and founded the Manchester and Salford Lying-in Charity, which, five years later, established a special hospital. 'In the nurture and management of infants, as well as in the treatment of lying-in women,' wrote Dr. Lettsom in his 'Medical Memoirs' of 1774, 'the reformation hath equalled that of the small-pox; by these two circumstances alone incredible numbers have been rescued from the grave.' The success of these institutions stimulated the establishment of other special hospitals, and particularly of dispensaries, for the infant poor in 1769, for general sickness in 1770, and for inoculation when that method became the fashion in the treatment of small-pox. Like the general and special hospitals, the foundation of which was a characteristic of the period, dispensaries were often originated by medical practitioners desiring a wider field for clinical work or teaching medical students. Fothergill, Lettsom, Armstrong, Wells, and Willan were among the leaders in this method of bringing the advantage of medical treatment, homely advice, and personal hygiene to the great mass of the people. In conjunction with such popular books as Dr. William Cadogan's 'Nursing and Management of Children' (1750), Lettsom's 'Hints' in leaflet form, the works on hygiene and paediatrics by Armstrong and Michael Underwood, and the English translation of Tissot's 'Advice' on health, they did much to organize medical and public opinion in the direction of infant and child welfare. It

was the beginning of a movement which reduced child mortality from 74 per cent of children born in 1730–1749 to 13 per cent in 1924.

(vi) *Medical Education*

Preventive Medicine depends upon education, and medical education in England may be said to have been first organized in the eighteenth century. Its evolution proceeded by four steps. First, there was from ancient times a system of apprenticeship, by which the medical practitioner had a pupil or apprentice to whom he taught the art and mystery of his craft. Then when hospitals were established the physician or surgeon took his apprentice to ' walk the wards '. This began at St. Bartholomew's in the seventeenth century, and the practice was adopted at the London Hospital in 1741, and at Edinburgh even before that. The London hospitals made informal arrangements with their medical staffs that their private apprentices should take a course of hospital work under their supervision. This arrangement proved advantageous, not only to the student, but to the hospital, for the student undertook a certain amount of routine work of the hospital service; and in due course buildings and appliances for the establishment of medical schools within or adjacent to hospital precincts were provided. The fees of the students went to the maintenance of the School and the payment on a share basis of the teachers. Thus the private apprenticeship system became something of a communal apprenticeship system in the hospitals. The medical staff became a medical faculty, and the apprentices became clerks and dressers in the wards. The third step was the holding of private classes in chemistry, anatomy, and pathology, and of clinical classes at the hospital. Before John Hunter, surgery was well taught only in Paris, and before the Monros began at Edinburgh, anatomy flourished only on the

Continent. Private instruction, such as that of Cheselden and Pott in surgery, Smellie's school of obstetrics, the Hunters' school of anatomy and surgery, Baillie's classes in morbid anatomy, and Harrison and Blizard's clinical class at the London Hospital, were the beginning of our modern ways.[1] The fourth stage, which overlapped with these proprietary classes, was the establishment of Chairs in the Universities. At the opening of the century, Chairs of Anatomy were founded at Edinburgh, Cambridge, Glasgow, and Oxford, and Chairs in Clinical Medicine at Edinburgh and Oxford. The London Medical Schools grew up in the eighteenth century alongside the great new hospitals which had just been built—Guy's, St. George's, the London, and Middlesex. In the following century they became associated with the University of London, but at first they were proprietary schools conducted wholly by medical practitioners. The unique position of Edinburgh in the eighteenth century was largely due to the fact that it was the most flourishing *University* Medical School in Great Britain. It was Sibbald, Monro, Rutherford, and Cullen who made it so. And the medical education both within the medical schools and beyond their walls was stimulated by the formation in the last half of the century of numerous medical societies which followed the example of the Royal Medical Society of Edinburgh, founded in 1734.

Thus the clinical bedside tuition of Boerhaave at Leyden was adopted in Britain in the eighteenth century, and developed into the clerking and dressing in the ward which became characteristic of medical education in this country. The proprietary classes in chemistry, anatomy, and pathology became University classes, and the teaching in the old physic gardens, which were numerous, became organized classes in botany and pharmacology.

[1] For further particulars of these classes, see Peachey's ' Memoir ', loc. cit., and ' Medicine in England during the Reign of George III ', by Arnold Chaplin (1919).

The Canon of Avicenna, the 'Ars Parva' of Galen, and the Hippocratic aphorisms, still taught in the seventeenth century, thus gave way to apprenticeship and clinical work in the hospitals, and this in turn developed in the nineteenth century to fully organized University Medical Schools.

(vii) *Inoculation and Small-pox*

I come lastly to the greatest of all the medical achievements of the eighteenth century, the introduction of the practice of immunity. It happened in this way. In 1713 Dr. Timoni, a Greek of Constantinople, wrote a letter to Dr. Woodward of London giving him 'an account of the procuring of small-pox by incision or inoculation, as it has for some time been practised at Constantinople'. This letter excited much interest in English medical circles, and through the good offices of Sir Hans Sloane, Dr. Pylarini of Venice, who had in fact practised inoculation in Constantinople, was induced to give his version of the practice. Thus it came about that in 1721 inoculation by slight puncture and insertion of the fluid matter from a small-pox sore was tried tentatively in London. In the meantime, Lady Mary Wortley Montagu, the wife of the British Ambassador to the Porte, 1717–1718, had had her own child, a boy aged 5, inoculated by a Greek woman under the direction of Maitland, the surgeon to the Embassy, and in 1721 Lady Mary got Maitland similarly to inoculate her little daughter, 4 or 5 years old, in London. As these and other cases quickly recovered, the Princess of Wales had her two children inoculated, and thus a custom for the practice was established. Owing to the advocacy of Mr. Maitland and of Dr. Nettleton of Halifax, there were as many as 200 inoculations in 1722, and 293 in 1723. No doubt the custom would have spread had it not been for the opposition of certain medical men, and some unexpected and apparently inexplicable fatalities, the effect of which was that from 1728 to 1740 inoculation, the

transmission of 'artificial' small-pox by inoculation from a case of natural small-pox, fell into abeyance.

Now it happened that at about the same time that inoculation was introduced here, it was also tried at Boston in New England, and later on in 1738 at Charleston in South Carolina, and there the practice followed by Kilpatrick was to inoculate very slightly and from artificially produced small-pox—i.e. from the inoculated and not from natural small-pox. In 1743 Kilpatrick came to London and, assisted by Dr. Frewen of Rye, a pupil of Boerhaave, carried out a large number of inoculations from arm to arm—artificial small-pox derived from artificial small-pox. Others went a step farther in attenuation by inoculating with recent fluid matter before the variolous fever had matured. Some inoculators, indeed, preferred to weaken the material inoculated so much as to make two inoculations necessary for protection. After 1754 the practice spread, and was encouraged by charitable agencies and dispensaries for gratuitous inoculation of the poor. In 1775 Lettsom projected a scheme for inoculating infants in their homes. Otherwise, as he urged, it came too late, as most children born in London contracted small-pox before they were seven. Yet in spite of the widening custom of inoculation, it did not prove itself a preventive of the disease. Indeed, it increased its incidence if not its fatality. Then, as now, there were also mild types of natural small-pox. 'There were cases which a physician could not save' said Wagstaffe 'and cases which a nurse could not lose.' But the London Bills of Mortality continued to show to the end of the century an average of 1,800 to 2,000 deaths from small-pox every year.

(viii) *Edward Jenner, Village Doctor*

It was this situation which stirred the enquiring mind of a certain village doctor down in Gloucestershire. His name was Edward Jenner, and he was born in 1749 at the

vicarage of Berkeley. After schooldays at Wotton-under-Edge and Cirencester, he was apprenticed to Mr. Ludlow, a surgeon at Sodbury, near Bristol, and there, about 1768 or 1769, he heard a young countrywoman say that she could not take small-pox, 'for I have had cow-pox'. This he pondered in his mind. In 1770, when he was 21, he came to London to be a resident pupil of John Hunter. They became great friends. Both of them were naturalists, but from the elder the younger received a new and enlarging inspiration, wider and deeper than his schoolboy lore of birds' nests and fossils. Happily Jenner declined an offer to go seafaring with Captain Cook, and after his two years with Hunter he returned to Berkeley, and there he lived the happy and busy life of a country practitioner. 'His height was rather under the middle size, his person was robust, but active and well-formed. In his dress he was peculiarly neat, and everything about him showed the man intent and serious and well prepared to meet the duties of his calling. . . . He was dressed in a blue coat and yellow buttons, buckskins, well-polished jockey boots, with handsome silver spurs; and he carried a smart whip with a silver handle. His hair, after the fashion of the times, was done up in a club, and he wore a broad-brimmed hat.'[1] In 1772 he began to receive some wonderful letters from Hunter, and these continued for twenty years. 'I shall be glad' wrote Hunter 'of your observations on the cuckoo and upon the breeding of toads; be as particular as you can.' Again, 'I wish you could remove the cuckoo's egg into another bird's nest, and tame the young one, to see what note it has. There is employment for you, young man.' Hunter wants many facts about blackbirds, bats, salmon spawn, herons, and always cuckoos; 'send everything you can get, either animal, vegetable, or mineral.' Jenner has a disappointment in love. 'I own I was glad' writes Hunter 'when I heard you was to be married to a woman of

[1] 'Life of Edward Jenner', by J. Baron, 2 vols., 1838, I. 15.

fortune, but "let her go, never mind her". I shall employ you with hedgehogs.' They discussed inoculation and cow-pox, for about 1775 Jenner thought of little else, and it was either in discussing this question or a case of its kind that Hunter made his famous reply to Jenner, 'Don't *think*, but *try*; be patient, be accurate.'[1] In a letter from Hunter to Jenner dated August, 1775, he refers to an experiment on a hedgehog, and he adds: 'Why do you ask me a question by the way of solving it? I think your solution is just; but why think—why not try the experiment? Repeat all the experiments and they will give you the solution.'[2] And this was the same John Hunter who said to Cline, 'I love to *think*.'

Jenner talked to his fellow-practitioners and neighbours, and in 1780 he told one of them, as they rode together, of the idea growing in his mind that cow-pox might prove the antidote to small-pox. Early in 1788 he married, and in 1789 he made the great venture and inoculated his own child, a few months old, with swine-pox matter, and subsequently on three occasions with small-pox virus. *None of these small-pox infections gave the child the disease.* Seven years later (1796) he inoculated James Phipps, aged 8½ years, with cow-pox matter from the hand of a dairy-woman who had contracted cow-pox from her master's cows, and three months later he inoculated the child with matter from a small-pox case. *Phipps did not get the disease.* Jenner continued his observations, and two years later published his immortal 'Inquiry into the causes and effects of the variolae vaccinae, a disease discovered in some of the western counties of England, particularly Gloucestershire, and known as the Cow Pox' (1798). Jenner was now a famous man with a unique repute spreading all through the world, and his 'vaccination' a universal method for preventing small-pox. Then, as now, there were critics and opponents. In 1811 he wrote to Lettsom that 'the chief impediments to its general

[1] Baron, I. 124. [2] Baron, I. 33.

adoption are our newspapers and some of our magazines. Whenever a case of what is called failure starts up, in it goes to a newspaper, with all the exaggeration with which envy and malice can garnish it.' Even educated people, he complained, 'decide upon the merits of vaccine inoculation unaided by a competent knowledge of the matter'.

What was it that Jenner actually did? He described cow-pox as he saw it in Nature, and he contributed to its differentiation from other similar outbreaks among animals. He showed that cow-pox was inoculable upon man, and could be transferred from man to man. Above all, he *proved* that vaccinia in man protected against small-pox. It may be said that not one of these three discoveries was new, and, speaking generally, that is true. Different persons, medical, veterinary, or lay, had made observations on these points. What Jenner did was to bring them together and *prove their validity*. It has been thus in all the great discoveries. Before Harvey, observers had written of the probable circulation of the blood, but it was left to Harvey to prove. Before Lister, observers had for a century noticed that wounds protected from the air or other forms of contamination healed better than wounds which had been exposed, but it was left to Lister to prove the case and demonstrate its practical application to surgery.

The Contribution of the Eighteenth-century Practitioner

The four supreme advances in Medicine in the nineteenth century were the discovery of anaesthesia and its application, the introduction of the antiseptic principle in surgery, the germ cause of disease, and immunology. It is the glory of the medical practitioner of the eighteenth century that he laid the clinical foundations upon which the nineteenth century built its brilliant superstructure. What was it that the practitioners did? They laboured as

individuals with relatively little interrelationship or co-ordination. They often worked in the dark, and almost always inductively. They began to *use* the autopsy to check their treatment; they introduced methods of precision in diagnosis; and almost unconsciously they began to apply the new physiology to their clinical work. It is only now that, looking back, we can weave their individual labours into terms of principle and collective advancement. They builded better than they knew. Turning the matter over in my mind, and as the result of both experience and reflection, I should say that quite apart from their contribution to culture and literature,[1] to therapeutics and to surgery, they moved English Medicine forward in eight preventive directions:

(1) They explored the circumstances of epidemic disease, and observed the causative relation of external environment to it, including the effect of climate.

(2) They introduced the principles of medical notification, of isolation, and of fumigation and disinfection, though their disinfectants were probably not germicidal.

(3) They advocated an improved and enlarged dietary, combined with restriction of spirit-drinking. Tea, coffee, vegetables, and fruit were warmly recommended by them.

(4) They initiated industrial welfare, and were the prime movers in the health and sanitary control of the factory system.

(5) They began the reformation of midwifery, first by undertaking the practice of midwifery themselves, and secondly, by improving the methods of delivery and the care of the lying-in woman.

(6) They first attacked systematically the problem of infant mortality.

[1] A century must be considered rich in literary medical men which contains Mark Akenside, Tobias Smollett, Sir Richard Blackmore, Mason Good, Armstrong, Garth, John Arbuthnot, Crabbe, and Oliver Goldsmith.

(7) They lent their support and service to the establishment of dispensaries, hospitals, and medical schools.
(8) They laid the early foundations of immunity.

No one can read the sober terms of this astonishing achievement without realizing the fruitfulness of the 'Hunterian period' in its legacy to modern Preventive Medicine. Epoch-making as that period was in anatomy, physiology, and the new principles of surgery, as expounded and interpreted by the scientific giants of the century—

'Who speed the stars of thought
On to their shining goals'—

it was still more far-reaching in the sphere of Preventive Medicine, which not only extended the frontiers of life for many persons then alive, but laid the foundations of the Public Health system of the succeeding century. Moreover, it must never be forgotten that this development was the work of the *private practitioner*. The conception of practical prevention was born in his mind, and sprang out of his *clinical study and experience*. 'Human experience, which is constantly contradicting theory, is' said Johnson 'the great test of truth.' Much of the work of the practitioner was immediately effectual; and all of it has proved in greater or less degree constructive. Like the great physiologists of his time, he returned to Nature for his observations and his guide, and like them he relied on her recuperative powers for his remedy.

The Practitioner of the Twentieth Century

A profound change separates the private practitioner of the twentieth century from his forerunner in the eighteenth. There are, of course, abundant features and conditions in common between them, not the least being

a growing and active sense of humanitarianism. But the gulf of a hundred years has fundamentally altered the outlook and occasion of the practitioner. There has been an immense growth in the knowledge and understanding of health and disease ; great tracts of the unknown have been staked out and explored ; owing to anaesthetics and asepsis, surgery has been revolutionized ; the *vera causa* of many diseases has been discovered ; and treatment has extended in all directions. The inevitable result has been a development of specialism. In the realm of Preventive Medicine this has led to the creation of special medical services, the appointment of medical officers for the poor, public vaccinators, medical officers of health and of schools, police and factory surgeons ; and a further evolution of the medical services for the army, navy, air forces, and the British Dominions beyond the sea. Then there have come to be specialists in tuberculosis and venereal disease, in diseases of the skin, eye, ear, nose, and throat, the heart and lungs, and nervous system ; and, alongside all this, an ever-narrowing specialism in pathology, bacteriology, and mechano-therapeutics. Moreover, many workers now devote their whole time to research work in the laboratory or otherwise.

The old order has vanished. *But the practitioner remains*, and, although he appears to be restricted in sphere because of the growth in specialism, he is not less important or effective. As our first line of defence against disease, he is the heir of two centuries. But he is more than that, as we shall see in a moment. Whilst the claims on him have grown socially more insistent and medically not less exacting, his power over disease has increased. The labours of his predecessors have removed many of his difficulties—pain and sepsis have been reduced, the ' fate ' of scourge and pestilence has gone, facilities and institutions have been provided, instruments of precision have been invented, his education and equipment have been vastly improved, his professional status

and opportunity enlarged. In the rapid growth of knowledge and skill, surgery has enormously widened its borders and become more preventive and conservative in spirit[1] ; a dozen vaccines are at the disposal of the practitioner, and a whole new pharmacopoeia of organotherapy and serum-therapy is available. The age of humours and miasmata has given place in the medical mind to the reaction of the body as between seed and soil, as between predisposition and resistance, as between certain cause and known effect. Scurvy and small-pox, typhus fever and cholera, have vanished from the daily routine, and the practitioner of the twentieth century faces a future of conquest of disease undreamt of by his predecessor of the eighteenth century. Nor can the general practitioner any longer escape definite relationship with the existing system of medical responsibility or fail to answer to the call to a wider sphere. For in whatever direction we look we find an ever-increasing burden of professional duty imposed upon him, with an ever-increasing responsibility to his medical colleagues and to the State.

In the great movement of polity by which the State has come to the aid of the individual citizen, three new conditions have emerged, the tendency of which has been to bring the practitioner of the twentieth century into an organized scheme of national Preventive Medicine. First, the statutory duties imposed upon the doctor in behalf of prevention have been greatly extended[2]; secondly, the old contract and club practice which began with the dispensaries of the eighteenth century has been transformed into the National Health Insurance system, by which a practitioner service has been provided for fourteen million people ; thirdly, the practitioner himself has become a direct agent in working for the health of

[1] See 'Recent Advances in Medical Education in England', 1923, p. 126.

[2] Ibid., pp. 127–128.

the community as well as the individual.[1] These are the governing circumstances which make the practitioner of the twentieth century something more than heir of the past, *for they give him new powers of using the legacy of the past to its highest advantage*. They create for him a new occasion. For they secure two practical results. They bring the patient to the doctor at an earlier stage, so that he may observe the signs and symptoms of the beginnings of disease, when the condition is both correctly diagnosable and more amenable to treatment. ' If we do not know the early signs of disease,' wrote Sir James Mackenzie, himself a practitioner, ' there is little hope of our achieving the aim of Medicine—the prevention of disease.' [2] They also enable the practitioner to interpret

[1] It is sometimes alleged that the public medical services are designed to exclude the private practitioner. But the contrary is, in fact, the case. For example, the Poor Law Medical Service has 4,000 medical officers for outdoor medical relief, practically all of whom are private practitioners ; the Post Office list of 3,500 medical men are all practitioners ; out of 1,450 Medical Officers of Health, 1,100 are private practitioners, and only 350 are whole-time officers ; of the 1,800 medical men engaged by local education authorities in the inspection and treatment of schoolchildren, 1,000 are in private practice ; of 1,770 certifying factory surgeons, all, hardly with exception, are private practitioners ; and the whole of the national insurance service is in the hands of private practitioners.

[2] ' The Future of Medicine ' (1919). The author urged the need for a closer study of the first signs and subjective symptoms of disease ; the predisposing conditions, the antecedent irritations (as in cancer), the part played by earlier disease (as in measles and its sequelae), the infective processes set up by dental sepsis, the investigation of pain and of irregular heart action, the observation of the effect of drugs, the classification and assessment of symptoms, the estimation of functional efficiency. Here is ample suggestion for the future work of the private practitioner, but if we desire more definite guidance, it may be found in the necessity of answering the questions of the patient. (1) What is the matter with me ? This is *diagnosis* ; (2) Can you put me right, and when ? This concerns *treatment* and *prognosis* ; (3) How and why did I get it ? This raises *causation* ; and (4) How can I avoid it in future ? This is *prevention*. These are questions every patient asks in some form or other. The

the purpose of Preventive Medicine, not merely as the negation of disease, but as attaining the highest possible standard of personal health, resistance, and capacity of body and mind. In a word, both the cause of disease is now more open to us, and the answer to it is no longer only a drug but a way of life. The ideal of Medicine is by prevention to defeat disease and lengthen man's days, but still more in the ultimate issue to emancipate the imprisoned splendours of the human spirit, and furnish a larger degree of happiness, contentment, and capacity. To achieve this larger liberty for man, it is necessary to follow in the footsteps of John Hunter and build on the foundations of his day, taking Nature for our guide, learning her secrets, and being obedient to her laws.

sound and considered answer to them is the duty of the practitioner. In the child welfare service, the school medical service, the insurance system, and the factory, he may now get his patient at the beginning of sickness ; in his maternity cases he now gets, or should get, the advantage of ante-natal supervision ; in paediatrics, of scientific feeding ; in cardiac and alimentary disease, instruments of precision and tests ; the fulfilment of his statutory obligations in respect of infectious disease, including tuberculosis and venereal disease, provides him with preventive methods ; every patient is a field of exploration and investigation into the causation of disease, and rheumatism, cancer, and the epidemic nervous diseases afford an urgent occasion ; every patient too is entitled to advice in personal hygiene.

	Dates in Life of John Hunter		*Some Collateral Medical Events*
1710	Birth of Cullen and Heberden ('Commentaries', 1802).	1710	Epidemic of small-pox.
1711		1711	
1712		1712	
1713		1713	
1714		1714	Idea of inoculation introduced into England. Fahrenheit thermometer.
1715		1715	
1716		1716	Period of high infant mortality began.
1717		1717	
1718	Birth of William Hunter at Long Calderwood, Lanarkshire.	1718	Lady Mary Wortley Montagu's son inoculated for small-pox.
1719		1719	Westminster Hospital founded.
1720		1720	Mead, 'Discourse on Plague'.
1721		1721	Inoculation for small-pox practised.
1722		1722	Ramazzini, 'Industrial Diseases' (Eng. ed.). Defoe, 'Plague Journal'.
1723		1723	
1724		1724	Guy's Hospital founded.
1725		1725	Freind, 'History of Physic from time of Galen'.
1726		1726	Stephen Hales measures blood-pressure. Edinburgh Medical Faculty founded.
1727		1727	Sir Isaac Newton.[1]
1728	Birth of John Hunter at Long Calderwood.	1728	

[1] Died.

	Dates in Life of John Hunter	*Some Collateral Medical Events*
1729		Influenza pandemic, and epidemic in London.
1730		
1731	William Hunter at Glasgow University.	Hoffman on chlorosis.
1732		
1733		St. George's Hospital founded.
		Influenza epidemic in London.
1734		Royal Medical Society of Edinburgh founded.
		Rogers on epidemic disease.
1735		Middle period of high death-rate in London (1720–1750).
1736		Linnaeus, 'Systema Naturae'.
1737	William Hunter under Cullen at Hamilton.	
1738		Boerhaave.[1]
		Population of London 725,000 (Maitland).
		Methodist Revival.
1739	Smellie settles in London.	Manningham's Lying-in Hospital.
1740		Hoffman on rubella.
		London Hospital founded.
1741	William Hunter comes to London.	Epidemic fever in London, highest mortality of century.
	Smellie teaches midwifery.	
1742		Hoffman.[1]
1743		Stephen Hales on ventilation.
		Influenza epidemic in London.
1744		
1745		Middlesex Hospital founded.
		Corporation of Surgeons founded.

[1] Died.

Year	*Dates in Life of John Hunter*	Year	*Some Collateral Medical Events*
1746	William Hunter's lectures begin.	1746	
1747		1747	Haller's ' First Lines ' on physiology published.
1748	John Hunter comes to London (Covent Garden).	1748	Fothergill on putrid sore throat.
1749		1749	Buffon, ' Histoire Naturelle '.
1750	Dissecting and Chelsea Hospital (with Cheselden).	1750	' Black Assize '. Hogarth's ' Gin Lane '.
1751	Dissecting and St. Bart.'s Hospital (with Pott).	1751	Population of England and Wales $6\frac{1}{2}$ millions.
1752	Smellie published text-book on midwifery.	1752	Sir Hans Sloane,[1] Cheselden,[1] Sir J. Pringle on diseases of Army.
1753		1753	Lind on scurvy.
1754	Surgeon-pupil at St. George's Hospital.	1754	Mead.[1]
1755	The Hunters discover placental circulation.	1755	Huxham on Fevers.
1756	John Hunter House-Surgeon at St. George's.	1756	
1757		1757	Haller's ' Physiology '. Lind's ' Naval Hygiene '. Black on CO_2.
1758		1758	Brocklesby's ventilated barrack hospital.
1759		1759	
1760	John Hunter staff-surgeon in the Army. Hewson.	1760	George III.
1761	Went to Belleisle.	1761	Morgagni, ' De Sedibus '. Brindley, Watts, Arkwright period begins.
1762	In Portugal and the Peninsula. William Hunter Physician to the Queen.	1762	Rousseau.
1763	Settles in London (Golden Square).	1763	

[1] Died.

Year	Dates in Life of John Hunter	Year	Some Collateral Medical Events
1764		1764	First pavilion hospital at Plymouth.
1765	Hunter's attempt to establish national school of anatomy.	1765	
1766		1766	
1767	Elected F.R.S.	1767	Sir G. Baker on Devonshire colic. Monro.[1] Haygarth at Chester and Percival at Manchester.
1768	Settles in Jermyn Street. Elected Surgeon to St. George's Hospital.	1768	Huxham.[1] Cullen's 'Nosology'. Lind on tropical hygiene.
1769		1769	Dispensaries for 'Infant Poor' founded.
1770	Hunter's School moves to Windmill Street. Cruikshank.	1770	
1771	Marriage to Miss Ann Home. Publishes 'Natural History of Human Teeth'.	1771	Morgagni.[1]
1772	Begins correspondence with Jenner. Earl's Court.	1772	Rutherford on nitrogen. Highest mortality of small-pox in century.
1773	Suffered from angina.	1773	C. White on management of child-birth.
1774	William Hunter publishes 'Anatomy of Gravid Uterus'.	1774	Hewson.[1] Howard, 'Winter Journey'. Priestley on oxygen.
1775	John Hunter commences course of lectures on Surgery (1775–1790).	1775	Lavoisier on oxygen.
1776	Surgeon Extraordinary to the King.	1776	Adam Smith, 'Wealth of Nations'. Bentham's 'Fragment on Government'.
1777		1777	Haller.[1] Howard on prisons.

[1] Died.

Year	Dates in Life of John Hunter	Some Collateral Medical Events
1778	Publishes second part of treatise on teeth.	Voltaire.[1]
1779		Frank's text-book on hygiene.
1780	Dispute with William Hunter.	Fothergill.[1] Wilberforce.
1781	Baillie comes to London. (Aged 20.)	Cavendish on hydrogen.
1782		Haygarth's fever wards.
1783	Death of William Hunter. John Hunter moves to Leicester Square. Now leading British surgeon.	
1784		Samuel Johnson.[1]
1785	His proximate ligature for aneurysm.	Sir G. Blane on 'Diseases of Seamen'. Withering on use of digitalis.
1786	Published treatises on 'Venereal Disease' and 'Observations on Animal Economy'. Appointed Deputy Surgeon-General to the Army.	Lettsom on drug habit and alcoholism.
1787	Reynolds's portrait. Received Copley Medal.	
1788		Influenza epidemic in London.
1789		Jenner inoculated swine-pox.
1790	Surgeon-General and Inspector-General of His Majesty's Forces.	Cullen.[1] Howard.[1]
1791		
1792		Galvani on animal electricity. Gas-lighting.
1793	Death of John Hunter (October 16th). Buried in St. Martin-in-the-Fields, re-interred in Westminster Abbey, 1859.	

[1] Died.

	Dates in Life of John Hunter		Some Collateral Medical Events
1794		1794	John Dalton on colour blindness (Atomic theory, 1804). Erasmus Darwin.
1795	Publication of 'Treatise on the Blood, Inflammation, and Gunshot Wounds'.	1795	
1796		1796	Lemon-juice made compulsory in naval diet. Jenner vaccinates Phipps. Willan on diseases of London.
1797		1797	
1798		1798	Jenner's 'Enquiry' published. Willan on skin diseases.
1799	Corporation of Surgeons acquire his museum.	1799	
1800		1800	Bichat on the tissues. Sir Humphry Davy on nitrous oxide gas. Cuvier.

5. John Keats

JOHN KEATS: APOTHECARY AND POET

¶ *Dedicated in the Centenary Year* (1921) *to* '*The Master of the Society of Apothecaries of London (Sir Shirley F. Murphy, K.B.E., F.R.C.S.), a Lover of Keats and the Head of his Medical Order*'.

I

A HUNDRED years ago there died from consumption in the Piazza di Spagna at Rome a young Englishman, a Londoner, who in a few short months had written his name, not, as he suggested, 'in water', but on the immortal pages of English literature. As a student he passed through the school of Medicine, suffered its discipline, and inscribed his name on the roll of the Society of Apothecaries of London. As a poet he was one of the mighty interpreters of Nature. He came out of obscurity into undying fame. As Shelley said of him:

> 'He is made one with Nature; there is heard
> His voice in all her music, from the moan
> Of thunder, to the song of night's sweet bird;
> He is a presence to be felt and known
> In darkness and in light, from herb and stone,
> Spreading itself where'er that Power may move
> Which has withdrawn his being to its own.'

John Keats was born at the end of October, 1795, at the Swan and Hoop Inn, Finsbury. His father, Thomas Keats, a west countryman, was head ostler in the livery stables attached to the inn and kept by Mr. John Jennings, whose daughter Frances he married. The young couple lived at the stables, which faced the open space of Lower Moorfields, and there were born to them five children, one of whom died in infancy. Thomas Keats was a man of sound common sense, intelligence, and energy, and his wife was lively, clever, emotional, and devoted to her eldest child John. The boys were sent to a small private school at Enfield kept by Mr. Clarke, whose son Cowden became John's near and true friend. While at school, and when only 8 years old, John lost his father,

who was killed by a fall from his horse. His mother married again, though not happily, and after a separation went to live, with the children, at their grandmother's at Edmonton, supported by the small fortune left by Thomas Keats. The early days of the poet Keats were thus spent between the Edmonton home and the school at Enfield. The three boys and their little sister Frances made, together with their mother, a happy family until her death from consumption in 1810, when John was 15. We know but little of the boy's early life. He was a bright, vivacious, high-spirited child, with a temperament which was both pugnacious and generous, popular among his schoolfellows, but with a strain of sensibility that tended to become morbid. He was not intelligent above the average, but at the age of 14 years suddenly developed, largely under the influence of Cowden Clarke, a love of books which became almost a passion with him. He sought out and devoured all and any books which came his way, especially if they were concerned with history, travel, romance, or ancient mythology. Burnet's 'History of his own Time', Virgil's 'Aeneid', Tooke's 'Pantheon', Lemprière's 'Dictionary', and, above all, Spenser's 'Faerie Queene', and later on the works of Milton and the new poems of Byron and Wordsworth, formed his principal mental diet. As a boy he prepared a translation of the 'Aeneid' and some 'Notes on "Paradise Lost"'.

At the age of 15, after his mother's death, he was taken from school and apprenticed (1811) for five years to a surgeon named Hammond at Edmonton. At the end of the fourth year, in 1815, his apprenticeship ended, and he entered at Guy's Hospital to finish his medical course. On July 26th, 1816, at the age of 21, he passed the examination as a licentiate of the Society of Apothecaries of London, and thus became qualified to practise Medicine and Surgery. Instead of doing so, however, he turned, on the advice of Cowden Clarke,

to literature. In his late school days, and in whatever leisure he could obtain during his apprenticeship, he had devoted himself to his hobby of books, and at the age of 18 he had himself begun writing verses, some of which were subsequently published in Mr. Leigh Hunt's *Examiner*. The year 1816 was memorable in Keats's career. In that year he not only qualified as a medical man, and published in the *Examiner* his first verses, but he also met a group of men, largely through the good offices of Cowden Clarke, who exercised a dominant influence upon him—Leigh Hunt, Reynolds, a fellow-aspirant to poesy, Shelley, Haydon the artist, and other congenial spirits like Severn and Wells—and thus our medical student found himself launched in a world of art, letters, and liberal thought. His own genius, which had already proved itself in some outstanding sonnets, one of which has become for ever famous, his immense industry and the influence and stimulation of his friends, began to produce extraordinary results. In the following year—1817—he published his first volume of poems, written in the previous eighteen months, including sonnets to Hunt, Haydon, and Cowden Clarke, 'Sleep and Poetry', the 'Epistles', the priceless sonnet on first reading Chapman's 'Homer', and other early poems. The book did not meet with the much-hoped-for success, and had to compete in the popular taste with the new books of Scott and Byron.

In 1817 Keats wandered from place to place, writing and reading. He went first to the Isle of Wight, then to Margate, then to Canterbury, spending the summer at Hampstead—where he made friends with Charles Wentworth Dilke and Charles Brown—and the early autumn at Oxford with another friend, Bailey; and in November he was at Burford Bridge, near Dorking. The winter was spent at Hampstead, where 'the immortal dinner' took place on December 28th—Haydon, Wordsworth, Keats, and Charles Lamb—and

during which period Keats attended Hazlitt's lectures on the English poets at the Surrey Institution. In March he went to Teignmouth to nurse his brother Tom, invalided with consumption, and whilst there he completed the task of the previous six months, the writing of 'Endymion'—which shows, as Mr. Mackail has recently pointed out, many signs of Keats's experiences during this period. In May, Keats and his brother Tom returned to his old lodgings in Well Walk, Hampstead, to be near their brother George, who was about to marry and emigrate to America. In June, 1818, he went with Brown to see them off from Liverpool, and from there the two friends set out on a walking-tour in Scotland, visiting the English Lakes, Dumfriesshire, Wigtonshire, Burns's country, Ayr, Glasgow, Inverary, Oban, and Inverness—a holiday which seems to have proved more exhausting than refreshing. However that may be, he returned to face the darkest and most difficult days of his life. The emigration of his brother George deprived him of his nearest and best friend; his brother Tom was now dying of consumption; and he himself was evidently already infected and his physical strength undermined. Moreover, the reviews of 'Endymion' were, in certain instances, not only unfavourable, but harsh and unfriendly, and impressed him with the uncertainty and precariousness of his literary career. Lastly, there were added the pangs of love, for he had met his fate in Miss Fanny Brawne—the daughter of a widow at Hampstead, for whom he contracted a hopeless but absorbing affection. 'The passion wrought fiercely in his already fevered blood,' says Sir Sidney Colvin, 'its alternations of doubt and torment and tantalizing rapture sapped his powers and redoubled every strain to which bereavement, shaken health, and anticipations of poverty exposed them. Within a year the combined assault proved too much for his strength, and he broke down.'

After Tom's death in December, 1818, Keats lived for twenty months with Brown at Wentworth Place (now Lawn Bank), Hampstead. Here his love consumed him ; here he spent his most fruitful days of clash and conflict ; here he first knew of his mortal fate ; in the garden of Wentworth Place he heard the nightingale, ' not born for death ' ; from this home he went forth to die in Italy. His proclivity to wander had not deserted him. He went to Chichester, to Shanklin, to Winchester, and back to London, and, though he made attempts to rally himself, a growing despondency tended to settle down upon him. Yet in these anxious months he produced some of his finest work—' Hyperion ', the ' Eve of St. Agnes ', ' Isabella ', ' Lamia ', and the famous ' Odes '. Hope and despair alternated through the spring and summer of 1820, varying with the steady advance of disease, the deceptive rally and the inevitable relapse, until in September he sailed with Severn in the *Maria Crowther* for Naples, reaching it after a chequered voyage of four weeks. They went on to Rome in November, lodging by the Spanish Steps under the Pincian Hill, and there, on February 23rd, 1821, John Keats breathed his last. His body was buried at Rome in the graveyard near the pyramid of Gaius Cestius. In the summer of 1823 Shelley's drowned body was found with a copy of Keats's poems in his coat pocket, and after the cremation of the body the ashes were laid in the same burial ground of which he had written in his preface to ' Adonais ' : ' It might make one in love with death to think that one should be buried in so sweet a place.'

II

What manner of man was Keats ? Sir Sidney Colvin, to whom all lovers of Keats owe an irredeemable debt, has given us a word portrait in the following terms : ' A

small, handsome, ardent-looking youth—the stature little over five feet; the figure compact and well turned, with the neck thrust eagerly forward, carrying a strong and shapely head set off by thickly clustering gold-brown hair; the features powerful, finished, and mobile; the mouth rich and wide, with an expression at once combative and sensitive in the extreme; the forehead not high, but broad and strong; the eyebrows nobly arched, and eyes hazel-brown, liquid-flashing, visibly inspired.' 'Keats was the only man I ever met' said Haydon 'who seemed and looked conscious of a high calling, except Wordsworth.' It is said that at Guy's Hospital he dressed rather shabbily and carelessly, disregarding appearances as he did opinions, but possessed an exceptional amount of moral and physical courage. Yet, though confident, he was shy and reserved. At that time he enjoyed good health, was fond of company, and had a fine flow of animal spirits. Even when, in 1818, he was writing 'Endymion' and went to nurse his brother Tom at Teignmouth, he was untouched by sickness. It must have been the long tendance on his consumptive brother in 1818 and 1819 which sowed the seed of his own tuberculous infection.

In his 'Oxford Lectures on Poetry' Professor A. C. Bradley, speaking of his character, says that Keats had 'virtue in the true and larger sense of the word'. He had 'an intellectual nature not merely sensitive and delicate, but open, daring, rich, and strong—exceedingly poetic and romantic, yet observant, acute, humorous, and sensible, intense without narrowness. . . . In quality the mind of Shakespeare at three and twenty may not have been very different.' The former idea of Keats as having a sensual and uncontrolled nature has long been discarded. He was sensitive, perhaps hyper-sensitive, and an important part of his poesy is in response to the call of the senses—'Oh, for a life of Sensations rather than of Thoughts'—but the more his character has been

studied the more virile it appears, and the less regard is paid to that ‘ morbidity of temperament ’ which he himself admitted (in 1817) as likely to prove his ‘ greatest enemy and stumbling-block . . . the cause of my disappointment’. The testimony of his friends and the men who know him best is to a man of much generosity, openness of mind—the mind should be ‘ a thoroughfare for all thoughts ’—good sense and honour, and still more as one of the warmest-hearted, most unselfish, and most sympathetic of men, a faithful comrade and a true friend. Sympathetic imagination, in fact, was the dominant factor in his genius. It was this all-round appreciation of human thought and affairs, combined with his skill of expression, that raised him to the plane of Shakespeare. Rossetti speaks of Keats as ‘ the one true heir of Shakespeare ’ ; Matthew Arnold declared also that in certain respects ‘ he ranks with Shakespeare ’ ; Sir Sidney Colvin, the most competent authority on Keats, thinks it probable that ‘ by power, as well as temperament and aim, he was the most Shakespearean spirit that has lived since Shakespeare ’ ; and the present Poet Laureate gives first place in the qualities of Keats ‘ the power of concentrating all the far-reaching resources of language on one point, so that a single and apparently effortless expression rejoices the aesthetic imagination of the moment when it is most expectant and exacting, and at the same time astonishes the intellect with a new aspect of the truth. This is found only in the greatest poets, and is rare in them ; and it is no doubt for the possession of this power that Keats has often been likened to Shakespeare, and very justly, for Shakespeare is, of all poets, the greatest master of it ’. When we think of this glorious kinship we may remember that Keats began as student of medicine and apothecary, he continued as poet, and he ended as ‘ philosopher ’ ; and, though the days of his life were few and evil, he left behind him the name of perhaps the most purely poetic genius that our race has known.

III

First, Keats was an apothecary. His adolescent life covered the brief period of ten years, from 1811 to 1820, and six of those were devoted to the study of Medicine, and in the last of the ten years he was a dying man. When, therefore, we think of his short career, we must not forget that during two-thirds of it he was being educated as a physician, a training which in those days involved some four or five years as a surgeon's apprentice followed by one or two years of hospital experience. He was, as we have seen, apprenticed to Mr. Hammond, an apothecary of repute at Edmonton, at the close of 1811, and he finished his medical course in July, 1816. The life of a surgeon's apprentice at the beginning of the nineteenth century was one of somewhat menial servitude to the master apothecary. In the days when the apothecary was incorporated with the grocer he not infrequently kept a small shop or dispensary, where he sold drugs and other articles such as sweets, preserved fruits, brown paper plaisters, toothbrushes, hair powders, and London or Venetian perfumery. After 1617, when a new charter separated the apothecary from the grocer, the former sold drugs and dispensed, as do the chemists at the present day. Later, the apothecary prescribed as well as dispensed, visited his patients, 'attended ladies at the most interesting period of their lives', as Thackeray says, and practised the art of Medicine as a fully qualified general practitioner. The apprentice lived with his master, was indentured for a fixed period on payment of a fee—it is believed that Keats paid £210—and was articled to serve his master faithfully in various capacities and pledged not to divulge his secrets, nor frequent taverns, nor play at dice, nor waste his time unlawfully. The apothecary, on his part, was covenanted to teach his apprentice 'the art, trade, mystery, and occupation of an apothecary', how to prepare and sell plaisters, pills, and ointments, and how

to treat his patients. He also provided the necessaries of subsistence. Crabbe's description of the workhouse apothecary in 'The Village', written in 1783, represents apothecary practice before the days of the amended Poor Law, though it was characteristically on the gloomy side. No doubt Keats lived a life of some monotony, perhaps even of drudgery, during the four years he waited on Mr. Hammond in his country dispensary practice at Edmonton. He can have learned but little of the Science of Medicine, however much facility he acquired in the routine of its daily practice. He was the unwilling witness, no doubt, of much of that suffering, disability, and tribulation, personal and domestic, which follow in the train of disease. From then to the end, sickness, as he said, was to be of his company. Little wonder that he sought happy literary evenings at the old school at Enfield, where he could revel with 'Cowden Clarke in the realms of gold'. Several of his early poems were written at Edmonton.

In the summer or autumn of 1815, more than a year before the expiration of his term of apprenticeship, he quarrelled with Mr. Hammond and left him, going, at the age of 20, to continue his medical studies in London at Guy's and St. Thomas's Hospitals, which stood on opposite sides of the street in the Borough, and which were associated together for teaching purposes. For the first winter and spring during which Keats was a surgical pupil at Guy's he lived in lodgings in Dean Street. 'Although the Borough is a beastly place in dirt, turnings, and windings, yet No. 8 Dean Street is not difficult to find', he writes to Cowden Clarke, and there they often met, ranging together in the bright and flowery upland pastures of literature, and there Keats must have written some of the lines which have made his name imperishable. There is the Wordsworthian patriotic stanza which appears in the poem 'To Hope', written in that year of tremendous import, 1815:

'In the long vista of the years to roll,
Let me not see our country's honour fade;
Oh, let me see our land retain her soul!
Her pride, her freedom; and not freedom's shade.'

This is comparable to Wordsworth's poem 'Near Dover' (1802), which contains the famous line, 'By the soul only the Nations shall be great and free'. More indicative of genius is Keats's sonnet 'On First Looking into Chapman's Homer'. He and Cowden Clarke had been spending an evening together at Clarke's lodgings in Clerkenwell over a folio copy of Chapman's Elizabethan translation of the 'Iliad'. Keats went back to his rooms in Dean Street and wrote the most famous poem any medical student has ever produced, and sent it forthwith to Clarke for breakfast next morning:

'Much have I travelled in the realms of gold,
And many goodly states and kingdoms seen;
Round many western islands have I been
Which bards in fealty to Apollo hold.
Oft of one wide expanse had I been told
That deep-brow'd Homer ruled as his demesne:
Yet did I never breathe its pure serene
Till I heard Chapman speak out loud and bold:
Then felt I like some watcher of the skies
When a new planet swims into his ken;
Or like stout Cortez when with eagle eyes
He stared at the Pacific—and all his men
Look'd at each other with a wild surmise—
Silent, upon a peak in Darien.'

In his third term he went to live with some fellow students (to two of whom he had been introduced by Sir Astley Cooper) in St. Thomas's Street, above the shop of a tallow chandler named Markham. One of them, Stephens, himself inclined to poetry, and subsequently

a practitioner at St. Albans and Finchley, tells us that 'little Keats' was fairly popular, though often teased on his pride, his poetry, and even his birth. 'He attended lectures' wrote Stephens 'and went through the usual routine, but he had no desire to excel in that pursuit. . . . Poetry was to his mind the zenith of all his aspirations.' Here he wrote part of the 'Endymion'—'a thing of beauty is a joy for ever'. In the summer of 1816, while continuing his work at Guy's, Keats left his student friends and joined his brothers in their lodgings in the Poultry, over a passage leading to the Queen's Head tavern, a residence from which in the following spring (1817) they all three moved for a short time to 96 Cheapside. Keats had by that time finished his medical course.

IV

Education in Medicine in the time of Keats included, in addition to the apprenticeship system, the study of anatomy (with which was taken physiology), taught by didactic lectures and the dissection of the body; the elements of pathology, learned mostly in the dead-house; materia medica and the medicinal use of herbs, acquired by dispensing, the study of botany, and work in the herb garden; surgery, mainly of a minor character, and learned by practice as a surgical dresser following the master in the wards of the hospital; and the practice of physic, which included therapeutics, the clinical examination of the patient, and the study of epidemic constitutions. Anaesthetics, the cell theory, the germ causation of disease, antiseptic surgery, and the revolution in medical science which these advances brought in their train, still lay hidden in the future. But the period was not, by any means, an age of darkness. William Harvey had demonstrated the circulation of the blood, John Hunter had established comparative anatomy and surgical pathology, Thomas Sydenham and his numerous

disciples had introduced the method of science into the practice of physic, Richard Mead had laid the foundations of public hygiene and sanitation, and Edward Jenner had introduced the principle of preventive inoculation. When Keats entered Guy's Hospital great things were moving in Medicine. Above all, there had been the return to Nature and a reliance on her processes.

Keats commenced his work by attending Mr. Green's anatomy demonstrations. (It was Mr. Green, the surgeon, who walked with Coleridge and Keats in the Highgate Lane in 1819.) Each lecture lasted about an hour and a half, and there was a good deal of dullness and repetition. Some of the manuscript notes which Keats took down are still extant, and indicate an industrious and accurate student—though, like all students, his mind would occasionally wander off to green fields and the open air. 'The other day, during the lecture,' he writes, 'there came a sunbeam into the room, and with it a whole troop of creatures floating in the ray, and I was off with them to Oberon and fairyland.' His medical text-books probably included those in vogue at Guy's at that time, such as Fyfe's 'Anatomy', 'The London Dissector', Innes on Muscles and Barclay on Arteries, Saunders's 'Practice of Physic', and possibly some of the larger works by Cheselden, Sydenham, Cullen, and Baillie. In 1818 Keats wrote to a friend, 'Every department of knowledge we see excellent and calculated to a great whole. I am so convinced of this that I am glad at not having given away my medical books, which I shall look over again to keep alive the little I know'. On March 16th, 1816, he was appointed surgical dresser to Mr. Lucas. Pupils were divided into apprentices and dressers, each surgeon having four followers, two of whom were dressers. Each dresser paid £50 per annum, the money being pooled and divided among the teaching staff. His duty was to 'dress' his patients and keep the notes of treatment and progress. Each surgeon went

round his wards twice a week at noon, accompanied by his dressers carrying a tin plaister-box, and all wearing their hats. Students also attended operations and autopsies. These were pre-anaesthetic days, and in this atmosphere Keats lived for two years.

While Keats's poems and letters do not reveal in any special degree the professional stigmata of Medicine, it cannot be doubted that his time at Guy's left an indelible mark upon his mind and outlook. The most famous teacher at the hospital in that period was Sir Astley Cooper, who in 1814 had been surgeon to the hospital for fourteen years. He was then 46 years old and in his prime, a great surgeon and a great teacher, the dominant figure in his profession. Sir Astley Cooper was endowed by nature with many fine qualities—a dignified presence, excellent physique, a critical mind, and exceptional powers of concentration and imagination—and these he devoted to his patients and students ; to the latter he was considerate and kindly, being particularly insistent, first, on the duty of accurate observation, and secondly, on the thorough and patient study of the processes of Nature. Keats was a zealous student, but whilst he drank in these truths his heart was elsewhere. A love of philosophy and the scientific method was not awakened at this stage of his development, and the practical responsibility and sense of suffering and pain lay heavily upon him. Nevertheless, he pressed through to the end. In July, 1816, he went up for the examination for a licentiate at the Apothecaries' Hall, and passed with credit. The new Apothecaries Act of 1815 had just come into operation, by which candidates were formally examined by a court of twelve examiners, the purpose of the Act being to prevent untrained and unqualified persons from entering the profession. Mr. Charles Hardwick was Master, and Mr. William Simons was Warden, of the Society of Apothecaries of London at that time, and Keats was one of the first candidates to submit to, and be successful

at, the new examination. There is no evidence that he ever undertook any medical duties after obtaining his diploma. On two or three occasions in the brief years that followed, particularly when depressed by hostile criticism of his literary work, Keats considered the advisability of practising his profession; once he contemplated going to Edinburgh for a physician's degree, another time, taking 'a situation with an apothecary', and in 1820 he suggested travelling abroad as the surgeon on board an East Indiaman. But these were passing fancies. His qualification as an apothecary ended the medical chapter of his life. It began his duty of superb alchemist.

V

It is impossible to believe that a medical training of six years had left no enduring effect on a sensitive and responsive mind like that of John Keats. Can the study of Medicine ever leave a man where it finds him? Whether he practises his profession or not, is he not marked for life? Does he not, in any case, at least bear the stigmata in the immediately succeeding years? Do we not find it to be so in Schiller, Goldsmith, and Crabbe, even though in less degree than in such medical poets as Oliver Wendell Holmes and Weir Mitchell? At the end of his six years of Medicine, Keats had but little more than four to live, and some things certainly he had learned which were not without effect on those remaining years. In the first place, there was a training of his powers of observation of Nature—the regal place of the infinitely little in the cosmos of the universe—the omnipresence of the sensuous and the law of cause and effect. A born lover of Nature, he became a trained and acute observer, and his poems and letters supply abundant proof of it. Sun and moon (and especially the moon in the beautiful verses in 'Endymion' and 'On a Summer's Day'), sky and cloud, mountain and

stream, the flowers of the field, bird and bee, Nature and man—they were all accurately apprehended and interpreted by Keats, together with a vision of their inter-relationship and purposiveness.

> 'I prest
> Nature's soft pillow in a wakeful rest.'

Another acquisition of his medical study was a new sense of positive action, of thoroughness, the need for system and organization, for knowledge and philosophy. Look at these wonderful words which he wrote in 1818:

'I mean to follow Solomon's directions, "Get learning—get understanding". I find earlier days are gone by—I find that I can have no enjoyment in the world but continual drinking of knowledge. I find there is no worthy pursuit but the idea of doing some good in the world. Some do it with their society; some with their wit; some with their benevolence; some with a sort of power of conferring pleasure and good humour on all they meet—and in a thousand ways, all dutiful to the command of great Nature. There is but one way for me. The road lies through application, study, and thought. I will pursue it; and, for that end, purpose retiring for some years. I have been hovering for some time between an exquisite sense of the luxurious and a love for philosophy: were I calculated for the former, I should be glad; but as I am not, I shall turn with all my soul to the latter.'

This noble passage meant that for Keats the 'latter' was his surrender to, and duty towards, 'the command of great Nature' combined with his mystical sense of something higher than and transfusing Nature—the service of man. He was to come at this by application, study, and thought, with the artistic temperament, it is true, but by the scientific method. And the master word was Work.

Again, Keats learned at Edmonton and at Guy's Hospital the larger exercise of compassion toward human suffering and love of human kind. 'Scenery is fine' said he 'but human nature is finer;' and this dominant sense of human sympathy was nurtured within him, not by literature, but by intercourse with men and women in the everyday life of the world—an experience he gained unconsciously, partly through the congenial friendships of Leigh Hunt's literary circle, but partly also in his six years of medical study.

Lastly, his study of Medicine gave him a fuller insight of the part which health and disease play in human affairs. 'Banish money—banish sofas—banish wine—banish music; but right Jack Health, honest Jack Health, true Jack Health—*banish health and banish all the world*' (1817). The unique value of health as an asset is here presented colloquially. With all doctors, Keats is a realist. His descriptions of the traffic and trail of disease are not less graphic and sure. 'It came like a fierce potion' he says in 'Isabella' 'which saves a sick man from the feathered pall for some gasping moment like a lance waking an Indian from his cloudy hall with cruel pierce.' Again, there is a contrast between the nightingale among the leaves and a hospital ward:

'The weariness, the fever, and the fret,
Here where men sit and hear each other groan;
Where palsy shakes a few, sad, last grey hairs,
Where youth grows pale and spectre-thin, and dies;
Where but to think is to be full of sorrow
And leaden-eyed despair.'

In 'Hyperion', too, there is this subtle touch of deterrence in the hospital patient:

'As with us mortal men, the laden heart
Is persecuted more, and fever'd more,
When it is nighing to the mournful house
Where other hearts are sick of the same bruise.'

Or at last, when on that sad day his own fatal malady came to its final stage, 'I know the colour of that blood; it is arterial blood; I cannot be deceived in that colour; that drop of blood is my death-warrant; I must die'. Oh, mortally wounded Keats!

'How very sad thy fate! . . .
How nigh
Was night to thy fair morning.'

Well, like all medical men of high endeavour, Keats found his energies divided between an habitual acceptance of Nature as it was expressed in and around him and an unanalysable perception of some spiritual ideal of which both Nature and man were the revelation. We must not let his medical training carry more than its due, for he himself said, 'Were I to study Medicine again, I feel it would not make the least difference in my poetry. When the mind is in its infancy a Bias is in reality a Bias, but when we have acquired more strength a Bias becomes no Bias.' While this is true enough, Keats had learned the inestimable lesson that creation implies positive action in a constant resolving of discord into harmony. He found, like Metchnikoff eighty years afterwards, that the struggle is between disharmonies and harmonies deeply rooted in Nature; and he learned before the end came that it was the medical man's highest duty to enter by sympathetic understanding into the life both of Nature and man, and by complete identification with the universe by 'fellowship with essence' to win for man the higher harmonies and the higher healing. And so he became in a larger and more enduring sense a wise physician and a consummate apothecary.

VI

Then Keats was a poet. The reader who for the first time takes up his poems is apt to find them disconnected,

confusing, and discursive; they have, as he said, a 'mazy dimness'. They seem to be the random expression, in ornate and decorative form, of a poesy which, though inevitable—the criterion of all true poetry—is purposeless. His verses crop out, effervesce, break away. Glorious lines which have entered permanently into our literature alternate with common stuff, 'unsteady and vagarish'; lofty and eternal themes seem to accompany transient and lowly ones. Keats himself recognized this, but out of the deeps of his experience he also said:

> 'There ever rolls
> A vast idea before me, and I glean
> Therefrom my liberty.'

It was Bacon who said that 'poetry submits the shows of things to the desires of the soul', and no one has more richly justified that definition than Keats. For he has shown, as no other poet, that truth and beauty are one, and together create liberty for the man who wins them.

Speaking broadly, the writings of Keats group themselves into four categories, 'Endymion', 'Hyperion', the 'Odes', sonnets, and shorter poems, and his Letters. His first volume of early poems appeared in 1817, when Keats was 22; 'Endymion' in 1818, while he was in Scotland; the immortal volume containing 'Hyperion', 'Lamia', 'Isabella', the 'Eve of St. Agnes', and the five famous 'Odes' came in July, 1820, when their author lay dying, a volume which contains most of the choicest flowers of his genius and belongs to all who love pure poetry; and the Letters were issued after his death. The five 'Odes' which stand in the front rank were those 'To Psyche', 'To Autumn', 'On Melancholy', 'To a Nightingale', and 'On a Grecian Urn'. 'Perhaps the two nearest to absolute perfection, to the triumphant achievement and accomplishment of the very utmost beauty possible to human

words,' wrote Swinburne, 'may be that "To Autumn" and that "On a Grecian Urn"; the most radiant, fervent, and musical is that "To a Nightingale"; the most pictorial and perhaps the tenderest in its ardour of passionate fancy is that "To Psyche"; the subtlest in sweetness of thought and feeling is that "On Melancholy".' To most of us the 'Nightingale' and the 'Grecian Urn' speak as does nothing else, and we feel, with Tennyson, that they contain 'the magic of the innermost soul of poetry'.

'Thou wast not born for death, immortal Bird!
No hungry generations tread thee down;
The voice I hear this passing night was heard
In ancient days by emperor and clown:
Perhaps the self-same song that found a path
Through the sad heart of Ruth, when, sick for home,
She stood in tears amid the alien corn;
The same that oft-times hath
Charm'd magic casements, opening on the foam
Of perilous seas, in faery lands forlorn.'

One cannot wonder as one reads these words that this ode has been described by a competent critic as 'one of the final masterpieces of human work in all time and for all ages'. The Letters which Keats wrote to his family and friends have proved to be the fullest defence of himself and the clearest illumination of his poems. They reveal homespun simplicity and tastes, with an abundance of common sense. 'Oh, there is nothing like fine weather,' he writes to his sister Fanny in 1819, 'and health, and books, and a fine country, and a contented mind, and a diligent habit of reading and thinking, and an amulet against the ennui.' To the bewildered student of Keats I would say, Read the letters! They are the windows of his soul. In them his genius is revealed as infinitely broad and human. The range and

scope of his mind become apparent, space is all about him, and his great phrases and images echo and reverberate, a word or a sentence flashes forth and travels away into the silence, but they tell of the largeness of his intellectual habitation. The letters are thus alive with mental vigour, humour, apprehension, and the power of criticism, and they breathe the natural wisdom of a man at home in the world, and with ample capacities of understanding. They show, too, as none of his poems can of itself, the freedom, the enlargement and enhancement, which the controlled imagination has to bestow. And all this wondrous harvest was sown and garnered in a handful of days. The first of his printed verses was 'The Imitation of Spenser', written in 1812, when Keats was 17; the last was the 'Bright Star' sonnet written at Lulworth Cove in 1820, storm-bound, *en route* for Naples—a period of eight years—but nearly the whole was concentrated into a brilliant epoch of half that length.

VII

We cannot here consider in detail the literary genius of Keats, but some broad and general things may be said. We have seen that as a boy he was fascinated by Spenser's 'Faerie Queene' and the 'Epithalamium', written in 1595 when Spenser was 43, and in which he relates his courtship and marriage. It is hardly too much to say that Spenser, who was born in the same part of London as Keats, 250 years before him, revealed to Keats the secret of his birth. 'It was the "Faerie Queene"' said Charles Brown 'which awakened his genius.' Spenser was a poet-painter, a metrical musician, possessing the imaginative opulence of a literary Turner, with a passion for the outward shapes of beauty, and alive to all the impressions of the senses. He seemed to live in an atmosphere of dreamland, silvery and faint and

mysterious as moonlight. His luxuriousness of romance, of decorative art, and of symbolism, appealed to Keats as a boy, who proceeded forthwith to embody his own dreams in similar form. The musical effect of the poetic use of vowels—'Spenserian vowels that elope with ease'—which long centuries before had given some of the Hebrew writers their impressive rhythm, struck a chord in Keats's soul, and hence he modelled his early work on Spenser. He was also fond of double-barrelled words, and the frequent use of passive words, such as calm, quiet, drowsy, soft, still, and silent, and of certain active terms, like 'tiptoe'—'I stood tiptoe upon a little hill', or 'sweet peas, on tiptoe for a flight', or 'tiptoe night holds back her dark grey hood'.

Then Keats, though not a scholar, was a lover of ancient mythology, and, like Shakespeare and Milton before him, selected his story and transmuted it, making it a vehicle or medium of his message. 'Endymion' was, as Keats modestly said in the preface, 'rather an endeavour than a thing accomplished' to recover the old Greek Nature myth of Endymion and Selene, and the nightly descent of the goddess to kiss her lover as he lay spellbound in everlasting sleep and youth. The vision of Endymion is for Keats the vision of beauty, and it is of the hunger and passion of the human soul for beauty of which he sings. But into his song he interweaves, not only other Greek legends, but the innumerable lights and shades of Nature and the spirit of ancient pastoral life. The subject of 'Isabella' was drawn from Boccaccio's 'Decameron'; that of 'Hyperion' from the warfare of the earlier Titanic dynasty with the Olympian dynasty of the Greek gods, and the dethronement of Hyperion, the sun-god; 'Lamia', the serpent-lady, came out of Burton's 'Anatomy of Melancholy'; and 'Psyche' and the 'Grecian Urn' reveal their own origin of Grecian imagination and art. But all these were mere imageries, mere channels for the expression of

beauty in one term or another, both in form and function. 'The form remains, the function never dies.'

This last remark makes it necessary to add at once a third character of Keats's poetry. It is detached, without design on the reader, and in itself a sort of disinterested goodness and truth. When we say that Keats used ancient lore or the enchantments of the Middle Ages as means to an end they were not stories retold with moral intent. The stories in Keats's setting were in themselves the poetry and the beauty, out of which his own joy and liberty sprang as if by nature. 'I see and sing by my own inspired eyes.' His joy, as Rossetti said, was a flawless gift. Wordsworth's pensive philosophy finds in Nature healing, strength, and spiritual meaning; Shelley sees in it a way of escape for the human spirit; Milton stands for its high purpose; Shakespeare is the embodiment of humanity; but Keats finds in Nature in its widest scope beauty and joy and liberty. He belongs to youth, the youth of the gods, eternal youth that knows no age. He is always seeking true standards of conduct, but they are to be innate and inherent in the very substance of his theme, and the joy and beauty of such truths are manifest in his poetry. Nature and poesy do not speak to him of beauty or tell him how to discover it. They *are* beauty and they are truth. He is only the interpreter of Nature for her own sake; he has the Greek instinct for personifying the power of Nature in human form; and he asserts for poetry, not the function of proclaiming doctrine or rationalism, but of creating beauty and being in itself disinterested truth.

Then, fourthly, Keats had imagination, as have all poets, for 'imagination' as Joubert says 'is the eye of the soul'. But in Keats it was precocious, emergent, far-reaching; and it was associated with exceptional regard for the facts of Nature and with his own joy in them. 'I am certain of nothing but of the holiness of the Heart's affections and the truth of the Imagination,'

he writes to Bailey in 1817. 'What the Imagination seizes as Beauty must be truth . . . all our passions are, in their sublime, creative of Essential Beauty.' He is released from the conventions and restraints, and abandons himself, as Colvin says, to 'delight in the beauty of Nature and the vividness of sensation, delight in the charm of fable and romance, in the thoughts of friendship and affection, in anticipations of the future, and in the exercise of the art itself which expresses and communicates all these joys'. What limits are to be placed on the imagination of a medical student of 20 who has never left London and yet who can write, 'Much have I travelled in the realms of gold'? Whatever faults of diction or error of fact that sonnet may contain, it is a priceless gem. It has immense movement, liberty, and gladness of heart, and that which is implied but unsaid is greater than that which is declared. The familiar opening lines of the 'Endymion' fall into the same category of lofty imaginative work:

> 'A thing of beauty is a joy for ever:
> Its loveliness increases; it will never
> Pass into nothingness; but still will keep
> A bower quiet for us, and a sleep
> Full of sweet dreams and health and quiet
>   breathing.'

The 'Ode to the Nightingale', or the 'Ode on the Grecian Urn', or Oceanus from the far-foamed sands, or those other lines in 'Hyperion' which begin:

> 'There is a roaring in the bleak-grown pines'—

all these breathe his vastness of imagination and make 'moments big as years'. Nor are his letters less powerful.

'Notwithstanding your happiness and your recommendation I hope I shall never marry,' he writes to his relatives at Louisville, on the Ohio. 'Though the most

beautiful creature were waiting for me at the end of a journey or a walk ; though the carpet were of silk, the curtains of the morning clouds ; the chairs and sofa stuffed with cygnet's down ; the food manna, the wine beyond claret, the window opening on Winandermere, I should not feel—or rather my happiness would not be so fine, as my solitude is sublime. Then, instead of what I have described, there is a sublimity to welcome me home. The roaring of the wind is my wife and the stars through the window-pane are my children. The mighty abstract idea I have of beauty in all things stifles the more divided and minute domestic happiness—an amiable wife and sweet children I contemplate as a part of that beauty, but I must have a thousand of those beautiful particles to fill up my heart. I feel more and more every day, as my imagination strengthens, that I do not live in this world alone, but in a thousand worlds—no sooner am I alone than shapes of epic greatness are stationed around me, and serve my spirit the office which is equivalent to a king's bodyguard—then " Tragedy with sceptred pall comes sweeping by". According to my state of mind I am with Achilles shouting in the trenches, or with Theocritus in the vales of Sicily.'

To this understanding of the nature of the ' self-absorption ' of the true artist or poet Keats had arrived, without help or guidance, when he was barely across the threshold of maturity. That fevered time in the life of the mind, between boyhood and manhood, which he spoke of in the preface to ' Endymion ', was past ; he was now in serene possession of his faculty of imagination inspired. He had been compared with Lord Byron. ' There is this great difference between us,' he writes ; ' he describes what he sees ; I describe what I imagine.' There is no longer a trace of the ' soul in a ferment, the character undecided, the way of life uncertain, the ambition thick-sighted '. His genius now faced the world, open-eyed

and resolute; ‘there is an awful warmth about my heart’ he wrote ‘like a load of Immortality.’

Lastly, Keats had received, as he believed, the commission of poesy, and he responded to it. His was a strange and mysterious, though not uncertain, dedication. All through his life's short day he yearned to ‘do the deed that my own soul has to itself decreed’. His poetry was a fine excess of his highest thought, ‘almost a remembrance’, coming naturally as the leaves of a tree. He passes in review ‘the countries that I see in long perspective, and continually taste their pure fountains’; then he sums up their attractions—the almond blossom, the rich cinnamon, the leafy world, ‘and the gems’—and rejects them all.

‘And can I ever bid these joys farewell?
Yes, I must pass them for a nobler life,
Where I may find the agonies, the strife
Of human hearts.’

And the way of choice and duty is Poesy, and the goal is poesy on the Happy Hill—‘that is all I care for, all I live for.’

‘O Poesy! for thee I grasp the pen,
That am not yet a glorious denizen
Of thy wide heaven’;

but, as he tells his brother George, ‘yet shall my spirit hold lofty converse with after times’. Though well aware of his limitations, he has no doubt of his high calling nor any as to his answer:

‘What though I am not wealthy in the dower
Of spanning wisdom; though I do not know
The shiftings of the mighty winds that blow
Hither and thither all the changing thoughts
Of man; though no great ministering reason sorts

Out of the dark mysteries of human souls
To clear convincing; yet there ever rolls
A vast idea before me, and I glean
Therefrom my liberty; thence too I've seen
The end and aim of Poesy.'

And 'the great end of poesy' is 'that it should be a friend to soothe the cares and lift the thoughts of man', unobtrusive, 'a thing which enters into one's soul'. In his own case Keats, though he forsook the vocation of apothecary, accepted the yet nobler calling of repairing the sorrows and wounds of men's lives by the healing power of beauty. Unless he undertakes this supreme task, he knows himself to be 'the essence of deformity, a coward'. But it is dual; for he is torn between the two powers of his heart, his imaginative instinct following the bidding of his senses, and his realistic appreciation of a social errand, an enterprise of action and character. It was a natural composition in a mind both imaginative and hungry for love, yet disciplined and stimulated in altruism; but the genius lies with the sensuous imagination, and it is his own. 'The genius of poetry' he says 'must work out its own salvation in a man. It cannot be matured by law and precept, but by sensation and watchfulness in itself. That which is creative must create itself.' That wondrous mission caught him, as a lad, unawares; it carried him 'round many western islands'; it sustained him amid disappointments and despair, even amid the terrific clash of the two ultimate experiences of Love and Death, and it brought him, all too swiftly, to the desired haven. 'No one else in English poetry save Shakespeare' wrote Matthew Arnold in his 'Essays on Criticism' 'has in expression quite the fascinating felicity of Keats, his perfection of loveliness. "I think" he said humbly "I shall be among the English poets after my death." He is; he is with Shakespeare.'

VIII

Lastly, Keats was a philosopher. In one of his letters he boldly claims that he is 'a philosopher first, a poet afterwards'. Chronologically, perhaps, it would be truer to say he was a poet first and subsequently a philosopher, but in any case the philosophy was the final issue. It was his life-blood. 'Axioms in philosophy' he wrote 'are not axioms until they are proved upon our pulses.' What, then, was his philosophy? It was this: *that beauty is truth; that such truth is power; that such power moulds the soul; and that the purpose of the soul is devotion to human service through personality.* I am, as it were, dissecting out the constituent elements, though in doing so I do not forget that all such analysis must be resolved in a synthesis.

The basis of Keats's philosophy is that beauty is a principle, is truth, or is, rather, a stepping by imagination towards or into the truth. That glorious sonnet on the legend of the Grecian Urn concludes in two immortal lines which almost sum up his case:

> 'Beauty is truth, truth beauty—that is all
> Ye know on earth and all ye need to know.'

Here he takes his stand, and by innumerable illustrations he presses home his conception. He finds beauty is manifest first in Nature and in the things of sense—a vision, a sound, a touch, a taste, a smell, even things sensuous—he finds a *principle* of beauty in all things beautiful and joyous, and thus the basis of a unity of all beauty. 'I have loved' he declares 'the principle of beauty in all things.' Then he goes a step farther. 'Keats came face to face' Professor Bradley writes 'with the pathos of the world, and *saw that it was good*; he saw without rebellion, and in the higher, more prophetic mood, the sadness of all sweet things that have an end.' He learned that 'the burden of the mystery'—the

suffering and sorrow and pain and conflict of life, and even death itself—are not foreign, not alien, not obstacles athwart our path, but circumstances aiding us, to be harnessed and used by us. Courageously he cries in 'Hyperion': 'Be thou therefore in the van of circumstance.' These forms of pathos are part of his vision of beauty. For, though not pleasing in themselves, or good to look upon, they are power-inciting, they mould, and give tone and fibre, flint and iron, to the soul. He will not rule them out; they are 'more beautiful than beauty's self'. Hence he solemnly welcomes them, and bids them enter his kingdom and complete the splendid consummation.

> 'Verse, fame, Beauty are intense indeed,
> But Death intenser—*Death is Life's high meed.*'

Having made his synthesis of beauty and seen it to be inseparable from truth, Keats finds it is also power. 'Wherever beauty dwells', he says in 'Endymion', the victory 'straight is won'; and again in 'Hyperion'—

> ''tis the eternal law
> That first in beauty shall be first in might.'

The speech of Oceanus is an interpretation of the dethronement of the old and brute force by the power 'more strong in beauty' of a higher ideal—light, knowledge, truth, 'symbols divine, manifestations of that beauteous life diffused unseen throughout eternal space'. In a letter to his brother and Georgiana Keats down in Kentucky he writes (April, 1819):

'The common cognomen of this world among the misguided and superstitious is a "vale of tears", from which we are to be redeemed by a certain arbitrary interposition of God and taken to heaven. What a little

circumscribed, straitened notion! Call the world, if you please, " the vale of soul-making ". Then you will find out the use of the world. I say *soul-making*. Soul as distinguished from an intelligence. . . . How, then, are souls to be made? How, then, are these sparks which are God to have identity given to them? How, but by the medium of a world like this?' And again he adds: 'Do you not see how necessary a world of pains and troubles is to school an intelligence and make it a soul?'

Thus he gives beauty, in whatever unpropitious circumstance, an ethical and social value—soul-making. What a letter to receive down in Kentucky! And the soul, inspired by the idea of doing some good in the world, is to be of service to others, and principally through itself, human personality and human love.

> ' They were my pleasures—they my Life's sad end;
> Love pour'd her beauty into my warm veins.'

The pursuit of Beauty is only justified, he urges again and again, when accompanied by the idea of devotion to the service of man. Of all human endeavour, that of healing the body and mind is nearest the divine.

Many of his amateurish and untechnical propositions are insecure, and not readily translated into modern philosophic terms, but the substance is there. As Professor Bradley pointed out in his ' Oxford Lectures on Poetry ', the duty of the poet thus becomes, in Keats's view, the duty of doing good. He is not to obtrude his mission nor reveal its design, but he is to make poetry—and in Keats's poetry Beauty itself—his philanthropy. In his apprehension of Beauty, Goodness and Truth, Keats had a foresight of the most enlightened modern social thought, whether scientific or altruistic. A recognition of his doctrine, it has been well said, would have meant a new life in society. It may do that even yet. That is what he

would have desired, and as he faced the inevitable doom of his last two years he felt more and more this high positive service. His lonely spirit soared—for no pulpit, as Rossetti said, could hold Keats's wings—it soared beyond the bounds to which it was set, and saw and felt the vision splendid. ' I value more the privilege of seeing great things in loneliness than the fame of a prophet.' Yet prophet, all the same and unawares, he became, the seer and interpreter of the gospel of Beauty, a prophet of Faith and Hope and Love—for the soul and for the nation ; a prophet who, in Shelley's noble memorial words in ' Adonais ', 'outsoared the shadow of our night '.

6. Louis Pasteur

THE CHARACTER OF LOUIS PASTEUR

¶ *A Layman's Homily, first written in* 1903.

THE CHARACTER OF LOUIS PASTEUR

L'œuvre de Pasteur est admirable ; elle montre son génie, mais il faut avoir vécu dans son intimité pour connaître toute la bonté de son cœur.—Roux.

No cypress-shadowed churchyard, nor the gloom
Of haunted cloisters doth immortalize
The dust of him whose patience proved more wise
To save, than Death to slay. The busy loom
Glancing with silk, the teeming herd, the bloom
Of purpling vineyards, and the grateful eyes
Of souls reprieved at Death's most dread assize,
Shall make eternal gladness round his tomb.
Not 'mid the dead should he be laid asleep
Who wageth still with Death triumphant strife,
Who sowed the good that centuries shall reap,
And took its terror from the healer's knife ;
Defender of the living, he shall keep
His slumber in the arsenal of life.

IT was Sir William Osler who said that the story of Pasteur's life reveals 'the true side of a great people in whom filial piety, brotherly solicitude, generosity, and self-sacrifice are combined with a rare devotion to country'. It is a story for all who wish to see what science has done, and may do, for humanity, and for those who assume that devotion to science is incompatible with reverence and belief in the Unseen.

Pasteur was born on December 27th, 1822, in the Rue des Tanneurs at Dôle, in the Jura. His father, Jean Joseph Pasteur, had been a soldier of the Empire who served in the Peninsular War, becoming a sergeant-major and receiving the Cross of the Legion of Honour. Subsequently, in 1814, he returned to the family occupation of a tanner, married Jeanne Etiennette Roqui, the daughter of a neighbourly market-gardener, and settled at Dôle. They seemed made for each other ; he, reserved and slow, circumspect and absorbed in his own inner life ; she, intelligent, active, full of imagination and

enthusiasm. They had five children, of whom Louis was the third.

Family interests and heritage took the Pasteurs away from Dôle, and they sojourned for a time at Marnoz, and finally settled at a tannery in the town of Arbois, near the bridge which crosses the Cuisance. This was the home of Louis Pasteur, and proved to be his golden milestone from which he measured the distances through the wide world. As a boy he went to the Primary School of Arbois, fished in the stream, and floated his ships on the tannery pool. On Sunday mornings he walked silently beside his father, who, wearing a military-looking frock-coat, spotlessly clean, and adorned with the ribbon of the Legion of Honour, invariably walked out between the vineyards along the Besançon road. These walks were deep in meditation concerning the boy at his side, the apple of his father's eye. In various simple ways the father began to instil into the boy's mind the strength, caution, and integrity possessed by himself, and he soon also taught him the ideals of patriotism, setting before the lad the glory of the French people as represented by the conquests of the Empire. Pasteur's biographer, speaking of these early days, says that Louis

'watched his parents day by day working under dire necessity, and ennobling their weary task by considering their children's education almost as essential as their daily bread; and as in all things the father and mother took an interest in noble motives and principles, their material life was lightened and illumined by their moral life.' [1]

When Louis Pasteur was 16 years old it became necessary to consider precisely what he should do. The head master of the Arbois School considered that, whilst

[1] 'The Life of Pasteur', by René Vallery-Radot, 1902, trans. by Mrs. R. L. Devonshire, Vol. I., p. 12.

instruction doubled a man's value, education in the highest sense of the word increased it tenfold; and, having perceived in Louis a hidden spark, urged the boy's father to send him to Paris to be trained in the École Normale, which had been founded in 1808 by Napoleon I with the object of training teachers. In October, 1838, therefore, we find Louis Pasteur, a raw country lad, with tears in his eyes and a lump in his throat, sitting on the top of the coach in the courtyard of the local inn, having said good-bye to his father, and having literally torn himself from his mother. In forty-eight hours he was in Paris, homesick and weary, although passionately desirous of setting to work to learn, in order that he might some day return to Arbois as teacher in the village school. His despair nearly overcame him, and his homesick letters caused anxiety. 'If I could only get a whiff of the tannery yard' he would say 'I feel I should be cured.' Thus it happened that before Christmas had come Louis received word from the school messenger that he was wanted at the café at the corner of the street, and there he found, sitting at a small table at the back of the shop, his father, with his face in his hands. 'I have come to fetch you,' was all the poor man could say. No explanations were necessary, for the broken-hearted father and son understood each other's longings only too well.

When Louis Pasteur got back to Arbois he must have felt that his early ideals were already dead, and that he himself would never become a teacher in the village school. But after a few months at home a second attempt was made, and the boy went to Besançon, which seemed to be not far from home, and after two years' study at the 'Royal College' he became a pupil-teacher. So successful was he that he began once more to dream of the École Normale in Paris, and accordingly set about preparing for some of the preliminary examinations. By day he taught; in the evenings he coached laggard

students, thus increasing his small salary; and in the silent hours of the night he studied to prepare himself for the École Normale. The way to the latter seemed more open, in that his schoolfellow, Charles Chappuis, a student of philosophy at Besançon, had already gone to Paris, and had entered the École. At last, in October, 1842, Pasteur found himself once more in Paris. This time he was no longer a forlorn lad with a broken heart, but a tall student of 20, capable of teaching and zealous to learn. His letters home speak no more of homesickness, but of classes and lectures, of laboratories and professors, of books and students, of industry and fixed determination. The expenses of his Parisian life, which was one of great simplicity and economy, were few, and by tutorial and other similar work he was able to earn a few extra francs. Regularly as clockwork letters went to the anxious parents at Arbois, which, though entering into the smallest details of his work, were inspired with ideals which seemed to enter like rays of sunlight into the little rooms of the humble tannery.

'You know how we worry about your health,' wrote his father. 'You do work so immoderately. Are you not injuring your eyesight by so much night-work? Your ambition ought to be satisfied now you have reached your present position.'

The father also wrote to Chappuis, Louis's bosom friend:

'Do tell Louis not to work so much. It is not good to strain one's brain. That is not the way to succeed, but to compromise one's health. Believe me, you are but poor philosophers [Chappuis was a student of philosophy] if you do not know that one can be happy even as a poor professor in Arbois College. . . . Remain two good friends.'

So the days passed, Pasteur beginning to dip into elementary chemistry, and working, without rest or holiday, so keenly that he managed to get himself locked into the laboratory all Sunday, or poached private lessons out of the laboratory attendants by night; Chappuis, the young philosopher, waiting outside day by day to take Pasteur for his daily walk in the Luxembourg Gardens, but unable to prevent him from talking all the time about his work. Indeed, Chappuis found that his companion was rapidly becoming a chemist, and the old argumentations on philosophy and mathematics gave place to tartaric and para-tartaric acids. Yet there was a steady undercurrent of literature, which young Pasteur held was 'a guide for general ideas'. His letters home became filled with the same matters, and his father, thinking that he was progressing too quickly, wrote back with the instinct of the sergeant-major: 'Before becoming a captain you must become a lieutenant'; but with true insight he urged that all learning was interdependent, and 'one science should be a help to the other'. His sisters counted the days between each letter from Paris, and the thoughts of the whole family were centred upon the great school where that son and brother worked, in whom the hopes of the family were placed. His mother had little time to write, but she watched for the postman with maternal anxiety. The records of the continual exchange of thoughts between the little tannery in the Jura and the young scientist in Paris are full of tenderness and affection, and marked throughout by simplicity, dignity, and spirituality. Some of the letters which were received were proudly read aloud to his little scholars by the head master of the Arbois School. They told of a life of hard work and exalted ambition; and from the retention of this personal connection arose an arrangement by which Pasteur undertook to act, on the one hand, as 'vacation lecturer' at the school, and, on the other, the delicate

position of tutor to his own father, who desired that his education might be improved in order that he might further help his two little daughters. Hence we have the pleasant picture of the old sergeant-major sitting up late at night in the little room above the tannery, when the house was silent and wrapped in sleep, puzzling his head over rules of grammar and problems in arithmetic, in preparing answers to send to his son in Paris. Alas! this happy devotion was soon interrupted by the sudden death of his wife. For weeks after the death of his mother Pasteur's intellectual life seemed suspended.

It was whilst at the École Normale that Pasteur made his first discovery. One day in 1844 he was puzzled over a fact he had encountered in his chemical studies, namely, that though tartaric and para-tartaric acids had similar crystalline form and chemical property, the former rotated the plane of polarized light, while the latter was inactive. On investigation he found tartaric had asymmetric crystals and para-tartaric symmetrical, with differentiation in kind of hemihedral facet. He thus learned that the molecules of tartaric as well as its crystals must be asymmetric, and that this characteristic influenced its rotatory power. One of the immediate results of his work on crystallography was his appointment as Professor of Physics at the Dijon Lycée. He taught both first- and second-year pupils, and these two classes occupied his time and strength. He preferred the second class, for it was a small one, and the boys worked; but the first-year class, which contained eighty pupils, was too large to teach satisfactorily.

At Strasburg and Lille

Whilst working at Dijon, eagerly and conscientiously, Pasteur anxiously desired to return to chemistry. Accordingly, in 1849, he accepted the post of Professor of Chemistry at Strasburg, and here everything pleased him except his distance from Arbois. It was not

unnatural that his circle of friendship should be presently enlarged by his intimacy with the family of the Rector of the Academy at Strasburg. In this family he perceived the same high ideal and, with superiority of education, the same simple-mindedness which existed in his own home at Arbois. He had proclaimed his intention of not marrying, but the sight of the Rector's daughter changed his mind, and within a fortnight of his arrival he addressed a letter to the Rector, asking for her hand in marriage. The period which followed this letter was all happiness. Pasteur's father and his sister Josephine came to Strasburg. The proposal of marriage was accepted, and the wedding took place on May 29th. Marie Laurent, who thus became the wife of Louis Pasteur, possessed almost every quality which such a man could wish for in his wife. In addition to the womanly virtues which characterized her, and which she exercised in such a way as to surround his life with so much of the peace and protection which he needed, she was also able to render him the most efficient services in his scientific work. From the beginning to the end of their married life, Madame Pasteur may almost be said to have worked in partnership with her husband, and actually shared his great labours. She loved him ' up to the point of understanding his work ', wrote M. Roux, and was ' not only an incomparable companion to Pasteur, but his best collaborator '.

Pasteur continued to work at Strasburg as hard as in Paris. In 1852 he undertook a journey of investigation, in order to study the various tartars employed by manufacturers, and in this quest visited Vienna, Leipzig, Prague, and other places, his letters to his wife containing many details concerning the different tartaric acids. On the 3rd of January, 1853, one whole sitting of the Académie des Sciences was given up to Pasteur and his achievements on the subject of tartaric acids. This was his first public triumph, and obtained for him the red

ribbon of the Legion of Honour. He had not won it in the same way as his father, but he surely deserved it as fully. He returned to Strasburg more than ever stimulated, gave up half the prize of 1,500 francs which had been awarded him to the buying of instruments, and set to work on his studies of crystals. It was not all easy work, and his letters show that he met with many disappointments. But two new deductions emerged, both unexpected. First, he began to contrast the repair of crystals with the healing of wounds; and, secondly, he found that a solution of tartaric acid may undergo fermentation, the common mould putrefying it on a selective basis. These two ideas changed Pasteur the chemist into Pasteur the bacteriologist, and sent him forth on a new adventure. It was Robert Boyle who had prophesied that he who could probe the nature of fermentation would probably explain the origin of disease. It was Pasteur who fulfilled the event.

'Every yesterday a dream of happiness,
Every to-morrow a vision of hope.'

By a strange coincidence, it was at the moment when his studies were bringing him towards the subject of fermentation that he was called to a district where local circumstance was to be a strong incentive and illustration to his new researches. In September, 1854, almost six years after going to Strasburg, Pasteur was appointed Professor and Dean of the new Faculty of Science at Lille, and it was in this post that he won his renown as a lecturer. The small theatre where he gave his chemistry lessons soon became renowned in the student world. As a lecturer he possessed confidence in himself, was clear in his explanations, followed out one chain of thought to its conclusion, and taught the essential importance of the students themselves observing and experimenting. When to these characteristics was added enthusiasm and a grave, penetrating voice, it is not to be wondered that

the students who 'sat under' Pasteur felt the magic spell of his mind and personality. It was in his inaugural lecture at Lille that he told the students that without sound theory practice is but a routine born of habit, and 'that in the field of observation chance only favours the mind which is prepared'. Happily he did not allow his lectures to interfere with his research work, and his studies on fermentation grew apace.

And the growth came about in this way. One summer's day in 1856 a manufacturer of Lille named Bigo, whose son was studying under Pasteur, walked into the laboratory to consult the young Professor about some irregular results which were impairing his production of beetroot alcohol. He came to a man whose mind was prepared by some months' reflection on the cause of fermentation, hitherto believed to be due to a chemical process. Pasteur promptly visited the factory, and found the irregularity was the presence of lactic acid, due to a living ferment. Out of this episode there came many experiments, by which Pasteur demonstrated that fermentation is always due to living microscopic organisms, that such organisms are neither spontaneously nor chemically created, but are introduced from without, by 'infection' or from the atmosphere, and that for every fermentation there is a particular organism.

His influence at Lille transformed the Faculty of Science in such a degree that the Minister of Public Instruction coveted Pasteur's services for a larger sphere. Accordingly, in 1857, Pasteur was recalled to Paris, and appointed, almost exactly twenty years after he first set foot there, Administrator of the École Normale. Unquestionably the long climb which had brought the raw country lad from Arbois to the Administratorship of the École Normale had been achieved by diligence, perseverance, and genius. 'Our Faculty loses a scientist of the first order,' said the Rector of Lille, on Pasteur's

departure. ' You have yourselves, gentlemen, been able to appreciate more than once all the vigour and clearness of that mind, at once so powerful and so capable.' As Administrator of the École Normale, Pasteur found that he had to reorganize the whole science department. His life became fuller month by month, and the amount of work he got through was prodigious. Other men might generalize and establish theories ; Pasteur tested and established facts. His life became devoted to science. He lived for nothing else. His accuracy, his persistence, his logic, and his fixed determination, were at this time in his life turning out some of the finest material that scientific France had ever produced.

The Claims of the Heart

Yet Pasteur was not a scientific machine only. For, though he verified all things by accurate observation or experiment, he had a vivid and trained imagination, and he had above all a tender and responsive heart. We obtain fresh evidence of this in the way in which Pasteur's work always came to a dead stop in the presence of family trouble. In September, 1859, his eldest daughter Jeanne died of typhoid fever at Arbois, where she was staying with her grandfather. For weeks Pasteur could not keep his thoughts away from his child, or from his home life ; and six years later, when his father, the old sergeant-major of the Empire, died, Pasteur's letters reveal himself to be a man of domesticity and religion. Counting up the ' marks of affection ' which he had had from his father, he writes :

' For thirty years I have been his constant care. I owe everything to him. When I was young he kept me from bad company, and instilled into me the habit of working, and the example of the most loyal, best-filled life. He was far above his position, both in mind and character.

. . . The touching part of his affection for me was that it was never mixed with ambition. You remember that he would have been pleased to see me the head master of Arbois College ! Yet I am sure that some of the success in my scientific career must have filled him with joy and pride. His son ! his name ! the child he had guided and cherished ! My dear father, how thankful I am that I could give him some satisfaction ! Farewell, dearest Marie. Dear children, we shall often talk of the dear grandfather. How glad I am that he saw you all again a short time ago, and that he lived to know little Camille.'

And then comes the claim of science, which was to Pasteur the supreme claim of his life :

'I long to see you all,' he concludes, 'but must go back to Alais, for my studies [on silkworm disease] would be retarded by a year if I could not spend a few days there now.'

Twice more—once in September, 1865, and once in May, 1866—Pasteur had to drink the same cup of sorrow. For both his little girls died, and he himself buried them in the churchyard at Arbois, beside his mother and his father. That little *cimetière*, indeed, represented a burden of sorrow for Pasteur, and often amid his scientific work his thoughts wandered away to its precious soil. It was in these times that Pasteur's wife proved herself everything to him, and his own clear soul was again and again revealed. It was at the end of this decade that two clouds came across his life. The first was his own illness, and the second was the Franco-German war. The old sergeant-major was right : Pasteur's mighty physical and mental efforts could have no other ending than a breakdown. Probably Pasteur himself knew this, but his vast enthusiasm for science claimed everything of body and mind. On October 18th, 1868—a date of bitter memory

to his family and friends—Pasteur, though only 46, had a stroke of paralysis due to cerebral haemorrhage, and it seemed hopeless to expect that he would live through it. Round his bed gathered his friends. 'I am sorry to die,' he turned and whispered to them; 'I wanted to do much more for my country.' All scientific Paris seemed to come daily to enquire anxiously after the patient, and intimate friends took it in turns to watch by his bedside day and night. Every morning the Emperor and Empress sent for news, and the public waited in the keenest anxiety for every bulletin.

After hovering between life and death for a month, Pasteur turned the corner and began to recover. He spent the days of convalescence in reading and in converse with his wife, daughter, and friends. Two of the books in which he was most interested at this time were Smiles's 'Self-Help', and Bossuet's 'Knowledge of God and Self'. Towards the end of December he was able to walk a few steps without support. Directly he could do this he desired at once to return to work. Eventually his family had to give way, and on January 18th he set out in an invalid carriage for Alais, where his silkworm disease experiments were proceeding. In a few weeks Pasteur was on his legs again and working as before.

The second trouble which filled Pasteur's life at this time was the Franco-German war. He was saddened to think that his ideal of the peaceful and beneficent destiny of France was to vanish. When he returned to Paris he found his students had become soldiers, and he himself, overwhelmed by the reverses which fell upon France, begged to be enrolled in the *Garde Nationale*, that he might fight for his country. The spirit of the sergeant-major in the son had to be reminded that a half-paralysed man is unfit for military service. Unable to serve his country except by his science, Pasteur left Paris, and with an aching heart went back to Arbois.

There he read and meditated, and would repeat again and again to himself, as in brighter days, '*Laboremus*'. Sometimes, when he was sitting quietly with his wife and daughter, the trumpet-call would sound with which the Arbois crier preceded the proclamation of news. Then everything was forgotten, and the great Pasteur, with anguished soul, would go out and mix with the groups of village people standing on the little bridge crossing the Cuisance, listen breathlessly to the official news, and then sadly turn back to the little room filled with the memories of his father. On the wall hung a large medallion of Napoleon, *L'Empereur*; on the book-shelves books on the Great Epoch, read over and over again by the old soldier who had died in the humble room which still reflected something of the imperial glory. 'We are paying the penalty of fifty years' forgetfulness of science,' wrote Pasteur to a friend—

'Of its conditions of development, of the immense influence on the destiny of a great people, and of all that might have assisted the diffusion of light . . . I wish that France may fight to her last man, and to her last fortress. . . . Every one of my future works will bear on its title-page the words, "Hatred to Prussia! Revenge".'

These words, and the fact that Pasteur gave his son to the war and wished to go himself, give us some indication of the iron which had entered into his soul, and of his passionate love for his country. Many times after this period Pasteur referred, in speech or in writing, to the heinousness of the crime of war. 'Right and Might struggle for the world,' he believed. 'Right, which constitutes and preserves society; Might, which overcomes nations and bleeds them to death.' He set the gains of peace and science over against the gains of war. He delighted to show that the future lay with those nations

which cultivated peace and supported science. Why did France find 'no superior man in the hour of peril'? he would ask. And his answer would be, because of her 'forgetfulness and even disdain' of science. At the end of his life, in his famous reply at the Pasteur Institute to President Carnot, there occur these words:

'If I might be allowed, M. le Président, to conclude by a philosophical remark inspired by your presence in this Home of Work, I should say that two contrary laws seem to be wrestling with each other nowadays—the one, a law of blood and of death, ever imagining new means of destruction, and forcing nations to be constantly ready for the battlefield; the other, a law of peace, work, and health, ever evolving new means of delivering man from the scourges which beset him. The one seeks violent conquests, the other the relief of humanity. The latter places one human life above any victory; while the former would sacrifice hundreds and thousands of lives to the ambition of one. The law of which we are the instruments seeks, even in the midst of carnage, to cure the sanguinary ills of the law of war; the treatment inspired by our antiseptic methods may preserve thousands of soldiers. Which of these two laws will ultimately prevail, God alone knows. But we may assert that French science will have tried, by obeying the law of humanity, to extend the frontiers of life.'[1]

Medical Research

In 1873 Pasteur was elected an associate of the French Academy of Medicine. And although this may not seem at first sight to be of significance, it formed an epoch in his life. For if we divide his scientific career into two chief periods, we may say that the first period, from about 1850 to 1873, was devoted to the study of

[1] 'Life of Pasteur', Vol. II., 289.

physical science; and the second period, from 1873 to the end of his life, in 1895, to medical science. Pasteur was a chemist, and not a physician. Yet he revolutionized Medicine, and it may be said that his direct labours on its behalf commenced with his election to the Academy of Medicine. This was to be no nominal membership. On the first day of his attendance, as he walked towards the desk allotted to him, his paralysed left leg dragging a little on the floor, not one of his colleagues suspected that this quiet and unassuming man would become the greatest revolutionary ever known in the Academy. Yet so it was to be, for Pasteur, though he never practised physic, laid the foundations on which was to be built a new pathology and new therapeutics. Though some members of the Academy considered that it was waste of time to listen to ' a mere chemist ', there was a small group of younger men to whom Pasteur was something more than a voice in the wilderness. Slowly but surely his influence grew, and his teaching was accepted. Briefly, it may be said that Pasteur based his early work for Medicine upon his work in fermentation.

From fermentation it was but two steps for Pasteur to the cause and prevention of disease. The steps were these. As in fermentation, so in infective disease, the cause is a special micro-organism, seen or not seen, introduced from without; and if and where such microbe of disease is cultivated under detrimental conditions, it becomes weakened and attenuated in its morbid activity, and if reintroduced into the body, becomes, not a virus, but a vaccine. In 1864 he had studied ' diseases ' of wine, and in the following year diseases of silkworms. Now he turned his attention in the same way to *anthrax* of animals; to *puerperal fever*, a form of blood-poisoning which may follow child-birth; to *chicken-cholera*; to *swine-fever*; and to *rabies*, or hydrophobia.[1]

[1] ' Pasteur and his Work ', by L. Descour, 1922.

This new knowledge had many strange and unanticipated ramifications. It laid the basis for the practice of preventive methods, and, most remarkable of all, it proved the foundation of the antiseptic treatment of putrefaction (suppuration) in wounds, associated with the name of Joseph Lister (afterwards Lord Lister). When in 1861 Professor Lister was appointed surgeon to the General Hospital at Glasgow, he had an opportunity for the practical study of putrefaction in wounds. In 1867 he explained the position at which he had then arrived in the following words:

'In the course of an extended investigation into the nature of inflammation and the healthy and morbid conditions of the blood in relation to it, I arrived several years ago at the conclusion that the essential cause of suppuration in wounds is decomposition brought about by the atmosphere upon blood or serum retained within them, and in the case of contused wounds upon portions of the tissue destroyed by the violence of the injury. To prevent the occurrence of suppuration, with all its attendant risks, was an object manifestly desirable, but till lately apparently unattainable, since it seemed hopeless to exclude the oxygen which was universally regarded as the agent by which putrefaction was effected. But when it had been shown by the researches of Pasteur that the septic properties of the atmosphere depended, not on oxygen or any gaseous constituent, but on minute organisms suspended in it, which owed their energy to their vitality, it occurred to me that decomposition in the injured part might be avoided without excluding air by applying as a dressing some material capable of destroying the life of the floating particles.'

This is the basis of Listerian surgery, and it is founded upon the work of Pasteur. The manner of its application has changed, but the principles remain. Every surgical

operation, minor or major, is in these days performed under the antiseptic system. In 1874, in a letter to Pasteur, Lister wrote :

'Allow me to take this opportunity to tender you my most cordial thanks for having by your brilliant researches demonstrated to me the truth of the germ theory of putrefaction, and thus furnished me with the principle upon which alone the antiseptic system can be carried out. Should you at any time visit Edinburgh, it would, I believe, give you sincere gratification to see at our hospital how largely mankind is being benefited by your labours.'

Fifty years' experience of antiseptic surgery has considerably improved the methods adopted, and to-day it is practised throughout the world. Little wonder that, in 1892, Lister said of Pasteur that he it was who had 'raised the veil which for centuries has covered infectious diseases', to the incalculable benefit of the human race.

Honour and Reward

In August, 1881, Pasteur came to London, and was welcomed by the Prince of Wales on behalf of Great Britain, and by Sir James Paget on behalf of the medical profession. At the inaugural meeting at St. James's Hall in Piccadilly, when he entered, he received an extraordinary ovation. The simple man turned to his two companions and whispered, with a little uneasiness, 'It is no doubt the Prince of Wales arriving; I ought to have come sooner'! He was much impressed with his visit, and particularly with the kindness shown towards him by the medical profession, the Prince of Wales, and the Crown Prince Frederick of Prussia.

'Pasteur was the greatest success of the Congress' it was reported; 'when his name was mentioned a thunder of applause arose from all benches, from all nations. An indefatigable worker, a sagacious seeker, a precise and

brilliant experimentalist, an implacable logician, and an enthusiastic apostle, he has produced an invincible effect on every mind.'

In 1882 Pasteur was elected to the French Academy, and it was on this occasion, in his speech of acceptance, that he made his famous attack on Materialism, and urged the vital importance to France of appreciating the spiritual and the unseen. Renan's eulogy of Pasteur was delivered on the same occasion. After comparing him to Galileo, Pascal, and Michael Angelo, Renan said :

'That common basis of all beautiful and true work, that divine fire, that indefinable breath which inspires Science, Literature, and Art—we have found it in you, sir. It is genius. No one has walked so surely through the circles of elemental nature ; your scientific life is like unto a luminous tract in the great night of the infinitesimally small, in that last abyss where life is born.'

After enumerating Pasteur's discoveries, Renan cried, 'Truth and good are the ends of thy life ; sacrifice all to that goal.' These were eloquent words, but there was much that Renan said that day which must have found but little response in the mind and heart of Pasteur. The days which followed Pasteur's reception at the Academy brought him many manifestations of honour throughout the world. He was received as a national hero at Nîmes, Montpellier, Aurillac, Dôle, Arbois, and many other places. Particularly interesting was his visit to Dôle, where a statue of Peace and Knowledge was raised in his honour, and a memorial plate was placed on the little house where he was born.

'Your sympathy' said Pasteur, in reply to the mayor, 'has joined on this memorial plate the two great things which have been the passion and the delight of my life : the love of science and the cult of the home.'

When he found himself standing before the tannery, in the lowly rooms in which his father and mother had lived, his heart was full.

'Oh! my father, my mother—dear departed ones, who lived so humbly in this little house—it is to you that I owe everything. Thy enthusiasm, my brave-hearted mother, thou hast instilled it into me. If I have always associated the greatness of science with the greatness of France, it is because I was impregnated with the feelings that thou hadst inspired. And thou, dearest father, whose life was as hard as thy hard trade, thou hast shown to me what patience and protracted effort can accomplish. It is to thee that I owe perseverance in daily work. Not only hadst thou the qualities which go to make a useful life, but also admiration for great men and great things. To look upwards, learn to the utmost, to seek to rise ever higher, such was thy teaching. I can see thee now, after a hard day's work, reading in the evening some story of the battles in the glorious epoch of which thou wast a witness. Whilst teaching me to read, thy care was that I should learn the greatness of France!

'Be ye blessed, my dear parents, for what ye have been, and may the homage done to-day to your little house be yours!

'I thank you, gentlemen, for the opportunity of saying aloud what I have thought for sixty years. I thank you for this fête, and for your welcome, and I thank the town of Dôle, which loses sight of none of her children, and which has kept such a remembrance of me.'

In April, 1884, Pasteur visited Edinburgh on the occasion of the tercentenary of the University, and received the honorary degree of LL.D. He was received with great enthusiasm, and after the chief celebrations were over he was entertained by the undergraduates

of the University with De Lesseps, Helmholtz, and Virchow. Pasteur addressed the students on the value of work and the meaning of enthusiasm.

'Whatever career you embrace,' he said, 'look up to an exalted goal, worship great men and great things. But if work should be the very life of your life, if the cult for great men and great things should be associated with your every thought, that is still not enough. Try to bring into everything you undertake the spirit of scientific method.'

When Pasteur returned to Paris he devoted himself almost exclusively to his work on rabies, which had occupied a large part of his time during the last three or four years. On July 6th, 1885, there entered Pasteur's laboratory a little Alsatian boy, accompanied by his mother. This little boy, who was 9 years old, had been badly bitten two days before by a mad dog. It was upon this boy, Joseph Meister, that Pasteur first tried his preventive anti-toxin treatment for rabies. Other cases soon followed, and evidence of the efficacy of the system accumulated rapidly. Two commissions of enquiry were instituted, the one by France and the other by England. Their conclusions were in support of the Pasteur treatment. It was then resolved to establish an institute for the preventive treatment of hydrophobia and other infective diseases, which was opened in 1888 by the President of the Republic. But Pasteur himself entered it a worn-out man, exhausted with his labours. As he walked round the new laboratories his mind recalled the lack of appliance under which he had worked forty years before, and he was happy to think that the material difficulties which had hampered him would be spared to those who came after him. Differing from those old men who are always praising the past, he had an enthusiastic confidence in the future. He believed in the

realization of his hopes for peace, for work, and for mutual co-operation among men.

At the celebration of his Jubilee in the Sorbonne, Pasteur was not strong enough to read his speech, which was read by his son. Pasteur was welcomed by the President of the Republic, by the Presidents of the Senate and the Chamber of Deputies, by foreign ambassadors, and by representatives of science. In his speech he expressed particular gratitude to the foreign delegates.

'You who have come from so far to give to France a proof of sympathy,' he said; 'you bring me the deepest joy that can be felt by a man whose invincible belief is that Science and Peace will triumph over Ignorance and War; that nations will unite not to destroy but to build, and that the future will belong to those who will have done most for suffering humanity!'

Pasteur's labours were done. The remainder of his days was spent in watching and stimulating his disciples who carried on the work. In November, 1894, he had a paralytic seizure, and, although a marked improvement occurred in December, he was too weak to travel or to work. From time to time his band of disciples brought him records of their studies, and asked his direction and advice. But he knew his days were few. One day a temporary exhibition was arranged in the laboratory, and the feeble old master was carried in to view it. On the tables had been placed the little flasks which Pasteur had used long years before in his experiments on spontaneous generation; there also were the rows of tubes used by him in his studies on wine; and there, in ascending order, the evidences of his discoveries. As he was carried round to look for the last time at these souvenirs of the past, he whispered to his assistants, 'There is still a great deal to do!' He was more than ever full of a desire to alleviate human suffering wherever it occurred.

Full of respect for the form of religion—the Roman Catholic faith—which had been that of his forefathers, he came to it simply and naturally for spiritual sustenance in these last weeks of his life. In June he was moved to Villeneuve-l'Étang, just outside Paris, where he spent those summer weeks in his simple room, or under the pine-trees and purple beeches on the lawn. His wife and daughter read to him very frequently. Biographies interested him as of yore, also memoirs and letters concerning the First Empire. Pasteur never tired of these memories, but he no longer looked with the same eyes on the glory of conquerors. The true guides of humanity now seemed to him to be those who gave devoted service, not those who ruled by might. He particularly admired the life of St. Vincent de Paul.

Pasteur died on Saturday afternoon, September 28th, 1895, surrounded by his family and disciples, in his little room of almost monastic simplicity. His body was embalmed, received by the Government of the Republic, and accorded a public funeral at Notre Dame. In January, 1896, it was laid in the new mausoleum built in the Institute itself, after the model of the tomb of Galla Placidia at Ravenna. On the marble walls are inscribed Pasteur's discoveries, and a sentence from his reception oration at the Académie des Sciences:

PASTEUR

1848
Dyssymétrie Moléculaire
1857
Fermentations
1862
Générations dites Spontanées
1863
Études sur le Vin
1865
Maladies des Vers à Soie

1871
Études sur la Bière
1877
Maladies Virulentes
1880
Virus Vaccins
1885
Prophylaxie de la Rage

'Heureux celui qui porte en soi un Dieu, un idéal de beauté, et qui lui obéit—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'Évangile.'

Pasteur as Interpreter

When we think of Pasteur at his zenith we think of a short thick-set man, whose left side is stiff and who is a little lame from paralysis; whose face is white, and whose broad forehead is deeply wrinkled; a countenance solemn, intent, penetrating, purposive, but also lovable and compassionate; the thick dark hair, the short grey beard, the piercing but kindly eyes—'eyes of grey-green colour like the sparkle of a Ceylon gem'—are all characteristic, as we say, of the man. The best portrait of Pasteur is generally held to be the painting by A. Edelfelt, which was executed in 1885, and represents Pasteur at work in his laboratory. These were the outward signs and attributes of the house in which he lived. Not till long after does the judgment rest more upon the meaning, the place, and the spirit of the man and less upon the externals. Yet it must be said that until this stage is reached a man is misjudged. What then is 'the main account' of Pasteur? We have seen the homely and single-minded character, the affectionate nature and tenderness, the dutifulness of Pasteur, but what was his message? It was a new interpretation, a new scientific method, and both were vitalized by patriotism and a mystic inspiration.

The nineteenth century will be looked back upon as a new birth of science. Of all the centuries of man's attainment in the direction of science the nineteenth stands pre-eminent. Its conquests furnish a story without any parallel in the history of human achievement. The swiftness of its advance was due in part to the removal of many ancient superstitions, prejudices, and trammels which in previous times beset free thinking in almost

every direction. It is unnecessary to recall that the conditions bringing about the Renaissance, the freer circulation of men, the discovery of the New World, the founding of the Universities, the invention of printing, etc., all contributed and made possible the enormous advance of science in the nineteenth century. But in the later age correct methods of investigation and research came to be adopted. The eyes of workers everywhere were opened to the immense possibilities of exact research. Again, such men as Faraday had further gained the ear of the world by proving the value of abstract truth, the utility of science, and the application of its findings to everyday life. Then steam power and electric transmission brought the world closer together, and the enormous growth of current literature prepared coming generations to be taught, second hand, the new truths which were being established, and furnished a channel of communication between active workers engaged in research. Hence it came about that Darwin, Pasteur, Helmholtz, Virchow, and Lister found themselves at the beginning of a new epoch in every way more fitted and more prepared than were former times for the work of Galileo, Kepler, Harvey, Descartes, or Newton. The times of the nineteenth century were ripe, and the advance was accordingly exceptional. Yet it soon showed the faults of its qualities, a tendency to credulity, and a tendency to materialism. The former led its victims into unproved positions ; the latter made its votaries mechanical, and it inaugurated, in part, the problem of religion *versus* science which so troubled the Victorian Era. The cure of the first was logic and exact methods of experimentation ; the cure of the second was spiritual apprehension, and the light of truth on religion and science. Such increase of light has been not a little due to the scientific men who have not allowed their studies to becloud their spiritual perception. This brings us to Pasteur—the man, who, though giving his life to science, knew its limitations,

who had a sceptical mind but a heart of faith, and who knew there were certain vital forces beyond his tests.

We may think of at least three ways in which Pasteur, partly consciously and partly unconsciously, gave to the world of science and the world of men a great message of which both stood in need. And first as to his *scientific method*. To immense industry, to natural caution, to the power of taking pains, to persistence in effort, to a singularly clear and original mind, Pasteur added a scientific method at that time relatively new. To use his own words, it consisted of three principles, namely, Observation, Experimentation, and critical Reasoning. Take any of his work, and you will find these principles were applied with accuracy, determination, and patience. One day he looks down a microscope. He sees what few men had ever seen before, myriads of micro-organisms in a fermenting fluid (butyric fermentation), and he observes the micro-organisms at the edge of the cover-glass are motionless, the others being freely mobile. ' Is the oxygen of the air killing the peripheral bacilli ? ' he asks. If so, more of it would stop the fermenting process itself. He passes free oxygen into a flask of this fermentation fluid, and the fermentation ceases. And he argues that certain fermenting micro-organisms develop and function only in the absence of oxygen (*anaerobes*). It was an episode, but it illustrates his method. He was exact in observation, thorough in experiment, accurate in reasoning. No one of all his critics criticized his work more severely and ruthlessly than he did himself. No half measures, no sanguine credulity, were satisfying to Pasteur. He was impatient of inexactitude. His mental attitude was one of habitual disbelief until he had his facts. These must be verified, then classified, and from them a strict and narrow deduction must be drawn. The appeal to the eye and the arbitrament of direct and natural experiment were the two sheet-anchors of his scientific teaching, learning, and research work. By the

application of this scientific method he brought orderly thought out of chaos. 'What hopes seized upon me' he said 'when I realized that there must be laws behind so many obscure phenomena.'

In the second place, he had *Imagination*, 'the eye of the soul'. It is the faculty by which light is thrown upon what is itself invisible, without altering its nature. It should be even more than that, it should be creative. Analysis dissects. It separates nerve from muscle, tendon from bone, limb from limb. It examines each organ separately, and allocates function to each component part. It is necessary before synthesis can be applied. But constructive imagination is beyond analysis or synthesis, for it is a faculty which may become, if rightly used, the guiding handmaid to research. It foresees, anticipates, projects. Its place in the interpretation of history and literature is to make dead men pass before us as if alive. Robert Lowe said of Adam Smith that he had a great knowledge of history, of law, of philosophy, and of almost everything that can make an accomplished writer; but that in addition he had the peculiar quality of entering into the mind of man, of anticipating and foreseeing human action, and that it was this faculty rather than learning which gave him the power of raising political economy to the dignity of a deductive science. This was, of course, the faculty of imagination.

Whence Pasteur derived his innate imaginative powers it is impossible to say. Partly it was from his mother, for women possess more of the native genius of imagination than men. Partly it was from his father, the Napoleonic soldier. On one of the inner doors of the little home at Marnoz the veteran had depicted a soldier in an old uniform, now become once more a peasant and a tiller of the soil. It is recorded that this figure stands against a background of grey sky and distant hills; leaning on

his spade, the man suspends his labours, and is lost in a reverie of past glory. It is only an allegory and poorly executed, but there is the faculty. Pasteur also was, at first, 'an artist', as his Arboisian friends termed it. The environs of Dôle and the records of the siege of Arbois provided material for the early exercise of his artistic and imaginative talent. Even when he came back homesick from his first visit to Paris in order to be re-stimulated by a 'whiff of the tannery yard', he returned to his coloured chalks, and soon passed beyond the powers of his art teacher. The boy's pastel drawings of his father and mother, the old nun of 82, of Chappuis and others formed a portrait gallery of a dozen or twenty commendable pieces. This too was the boy whose letters home teem with thoughts of fancy, the embryonic of imagination. Is it wonderful that this boy became a man, became, in the true sense of the word, a Seer?

'Without theory, practice is but routine born of habit,' said Pasteur to his pupils at Lille. 'Theory alone can bring forth and develop the spirit of invention. It is to you specially that it will belong not to share the opinion of those narrow minds who disdain everything in science which has not an immediate application. You know Franklin's charming saying. He was witnessing the first demonstration of a purely scientific discovery, and people round him said, "But what is the use of it?" Franklin answered them, "What is the use of a new-born child?" . . . A theoretical discovery has but the merit of its existence. It awakens hope, and that is all. But let it be cultivated, let it grow, and you will see what it will become.'

These are words uttered in the early stage of his career. Now we know how he lived up to them. We know that this man of hope and imagination, who dreamed dreams and saw visions, became one of the greatest workers and

craftsmen in science the world has known. Who would have supposed that out of a study of philosophy would come crystals, and out of crystals would come forth the discovery of the cause of fermentation? or out of fermentation would be born the great law of biogenesis, and the etiology of infective disease? In an old letter from Joseph Pasteur to his son Louis, written in 1843, the father suggests that the various directions of study in which the son was engaged should not hamper each other, 'but on the contrary, one should be a help to the other'; thirty-five years later Pasteur told the Académie that 'all sciences gain by mutual support'. Thus it came about that philosophy and history led to chemistry, chemistry led to physics, physics to biology, biology to medicine. The cause of this sequence in Pasteur's work was imagination.

Yet Pasteur's imagination proved fruitful, not alone because of its existence and exercise as such. There were two controlling factors—first, the strict self-criticism, the absolute harnessing, by observation, of personal imagination; and, secondly, the high degree of co-operation between his faculty of imagination and his faculty of experimentation, 'the scientific method'. Fertility of imagination cannot alone secure the highest achievement. Sound judgment and a strict curb on imagination are as essential as fertility; there must be a delicately adjusted balance between the powers which stimulate imagination and the powers which hold it in check. It was this combination, this genius, which gave us the work of both Darwin and Pasteur. Neither man stumbled upon new facts or conclusions by accident. Each found what he was, with a prepared mind, looking for.

In the third place, Pasteur was a man of high *character and goodness*, who, believing in the power of the Unseen, dedicated his life to the public service. Early in boyhood he had been taught the 'fixed idea' of Milton, namely, that of the necessity of moral integrity to a life of truly

great work or endeavour of whatever kind. Moral purity, a conscience void of offence, reverence, faithfulness, love of home, love of duty, service—these were the priceless assets of the poor little tannery dwelling where the genius of Pasteur was reared and trained. 'In his growth the man kept pace with the scientist,' said Sir William Osler; 'heart and head held even sway in his life.' His father, his mother, his wife, his friends, were each in their turn dominating factors. He would appear before the world as critical, sceptical, determined, defensive; and yet inside him burned live coals from the altar of love, faith, and service. He feared the materialistic influence of the age. At his reception by the Académie française—'the forty immortals'—he boldly spoke to the nation of the errors of Materialism on the one hand and of Positivism on the other. In brief he condemned both, the former because it went too far, and the latter because it did not go far enough.

'Positivism' he said 'does not take into account the most important of positive notions, that of the Infinite. . . . The human mind, actuated by an invincible force, will never cease to ask itself: What is beyond? It is of no use to answer: Beyond is limitless space, limitless time, limitless grandeur; no one understands these words. He who proclaims the existence of the Infinite—and none can avoid it—accumulates in that affirmation more of the supernatural than is to be found in all the miracles of all the religions; for the notion of the Infinite presents that double character, that it forces itself upon us and yet is incomprehensible. When this notion seizes upon our understanding we can but kneel! . . . I see everywhere the inevitable expression of the Infinite in the world, through it the Supernatural is at the bottom of every heart. The idea of God is a form of the idea of the Infinite.'[1]

[1] 'Life of Pasteur', Vol. II., p. 157.

We have but to think of France in 1882 to understand what these words meant. Nor had his patriotism any less significance. It was a consuming fire. His insistent questions to himself and to the youth of France were these: 'First, what have I done for my own education? Secondly, what have I done for my country?' At the end of the address to the Académie came the words which, as his biographer says, 'are worthy of being preserved for ever, for they pass over humanity like a divine breath':

'Blessed is he who carries within himself a God, an ideal of beauty, and who obeys it; ideal of art, ideal of science, ideal of the fatherland, ideal of the virtues of the Gospel, for therein lie the springs of great thoughts and great actions; they all reflect light from the Infinite.'

If we take these great words, surely among the greatest in any language, and apply them to ourselves or to the giants of the human race, we shall know how few there be who find the truth which they contain, or, finding it, live in it and guide their lives by it. At that time many of the misconceptions of spirituality which were so prevalent were traceable, then as now, to the notion that spirituality is attained by eliminating, leaving behind, and transcending that which appertains to Nature, instead of by absorbing, using, and developing it. Such conceptions forget 'that there are two men in each one of us', as Pasteur expressed it—

'the scientist, he who starts with a clear field, and desires to rise to the knowledge of Nature through observation, experimentation, and reasoning, and the man of sentiment, the man of belief, the man who mourns his dead children, and who cannot, alas! prove that he will see them again, but who believes that he will, and lives in that hope; the man who will not die like a vibrio, but who feels that the force that is within him cannot die.[1]

[1] 'Life of Pasteur', Vol. II., p. 28.

The man who uttered those words worked in his laboratory, a silent searcher in the abysses where life is born, a hard, keen, logical, orderly machine, but with 'a scroll of high thought always in his bosom', with his heart and mind illumined with some ray of the fountain light of all our seeing. Thus only is great achievement won—by the combination of the mind and the heart, the practical man and the Mystic, the scientist and the Seer.

Some men's lives are sermons. Pasteur's was one. Faults he had, no doubt, and his work was not immune from error, but he knew the limitations of science, that it deals with correlations, and cannot penetrate primary causes; he knew the principles upon which true scientific work was to be accomplished; he devoted his life to the search after truth. This was the message which he gave to the world at the epoch when it was most needed. Is it strange that he was named 'the glory of France'? was it extravagance that said 'he was the most perfect man who has entered the Kingdom of Science'?

7. William Osler

A PHYSICIAN OF TWO CONTINENTS

¶ *A Memorial notice printed in January*, 1920.

A PHYSICIAN OF TWO CONTINENTS

I

WHEN Sir William Osler died in Oxford at sunset on December 29th, 1919, there passed from the earth one of the great physicians of our time. The whole world has sustained a loss. In him there was found a width of medical experience perhaps unique, a knowledge of medicine in East and West, a professional practice and a learning not often combined in one man. More than that, in his radiant life was to be found at its best the high spirit of Humanism. He became a *doyen* Professor of Medicine, having taught consecutively in great medical schools for the tremendous period of forty-five years. He became in his own person the first representative of the Anglo-American Fellowship of Medicine, which it was his joy to see founded at the end of the war, and over which he presided until his death. He taught that disease knows no frontier, and his faith never failed in the spirit of Anglo-Saxon Medicine, in its splendid traditions, its great achievements, in the simplicity of its methods, the daring of its inductive reasoning, and the new realm of Preventive Medicine opening before it. With an almost passionate enthusiasm he worked to promote that spirit, and the seed which he sowed will bear fruit in all nations for years to come.

II

The Oslers were a Falmouth family, and Sir William Osler's father, Featherstone Lake Osler, was born there in 1803. Subsequently, he went to Canada as a missionary, and eventually became Rector of Ancaster and Dundas in Ontario. His wife, who died several years ago, aged 100 years, was Ellen Free Picton, of London, and of her

sons one, Sir Edmund Osler, became member of the Dominion House of Commons; a second, a Justice of the Appeal Court in Ontario; and a third, William, entering Medicine, became famous throughout the world.

William was born at Bond Head, Ontario, July 12th, 1849. He went to school at Weston, near Toronto, his schoolmaster, W. A. Johnson, engendering in him his love of natural science and his taste for literature. It was at school that he was introduced to the 'Religio Medici' of Sir Thomas Browne and became for life his ardent disciple. It was his own copy of the 1812 edition of the 'Religio' purchased about this time which lay on his coffin in Christ Church Cathedral at Oxford fifty-two years later. From school he was sent to the Trinity College School of Medicine, and subsequently to McGill University at Montreal, where he graduated in 1872. McGill University received its charter in 1821, and the medical school was established eight years later as a continuation of the Montreal Medical Institution (founded in 1823–1824). It was designed on the English model of medical school and received much of its early inspiration from Edinburgh. Hence it came about that in 1872 Osler crossed the Atlantic to continue his studies in Edinburgh and London, in Berlin and Vienna. This first professional visit to the famous medical schools of Europe did much to mark Osler's career. For there he not only met some of the leaders of Medicine in the last half of the nineteenth century, but he obtained an insight into methods which bore rich fruit in his own experience. In London he studied physiology and histology at University College under Professor Burdon Sanderson (whom he succeeded thirty years afterwards at Oxford) and clinical Medicine in the wards of the hospital under Sir William Jenner, Wilson Fox, Bastian, and Ringer, four teachers who left an indelible mark upon him. The autumn of 1873 was spent in Berlin under Virchow, Traube, and Frerichs, where he shared

in the work of the systematic medical clinics then characteristic of Germany, and the first five months of the following year were devoted to Vienna, in the classes of Hebra and Bamberger. Thus when, in September, 1874, Osler returned to Montreal, he was *au courant* with the best medical practice of East and West, and he was coming home to an expanding medical school, an expansion which reached its zenith in the new buildings of 1910.

Speaking generally, there were three particular things that he had learned. The system of clinical study by which the student acquires his profession at first hand in the wards by 'clerking' with a physician and 'dressing' for a surgeon lies at the foundation of English medical education; it produces the practical observer; it brings the student into direct touch with his patient and with disease; it imposes, from the outset, a definite responsibility upon the student; he becomes, in fact, an 'apprentice' of the good old sort but with wider opportunity; it makes him, in a word, a student practitioner. When Osler came to this country he saw this system at work and recognized its intrinsic value. Then he also saw the study of the out-patient as the first essential step in medical practice; there is the large waiting-room filled with the sick and halt who have come for relief, each passing in his or her turn into the doctor's hands for diagnosis, and being referred for the suitable form of treatment or admitted into the wards as an in-patient. This is the earliest opportunity for the science and art of Medicine, for here it is possible to see disease at its beginnings, here the elements of the art of practice are acquired. Osler saw the student was thus taught his work in direct and personal fashion. 'Do not think' said John Hunter 'but try.' Thirdly, when he crossed into Germany and Austria, Osler left this English genius of Medicine behind, for there he found the student had no such individual opportunity

for actually serving the patient. But he found something else—he found the medical clinic highly developed and the diagnostic or clinical laboratory associated with it—a vigorous, comprehensive, and somewhat elaborate form of teaching the student by means of systematic demonstration, usually taking different types of disease in succession. Traube, of the Charité at Berlin, proved to Osler the value of this method of organization.

III

When Osler returned to Montreal in 1874, he was appointed, 'a young and untried man', to the professorship of the Institutes of Medicine. He was only 25 years old, and the 'awful task' of preparing and delivering a hundred lectures in the session impressed him. 'My first appearance before the class' he wrote long afterwards 'filled me with a tremendous uneasiness and an overwhelming sense of embarrassment. I had never lectured before. With a nice consideration, my colleagues did not add to my distress by their presence, and once inside the lecture-room the friendly greeting of the boys calmed my fluttering heart, and, as so often happens, the ordeal was most severe in anticipation.' The Institutes of Medicine in that day included physiology and pathology, and Osler taught both, but particularly the latter. It was at McGill that he laid the foundations of his knowledge of disease and of the necessity of integrating the science of physiology with clinical work. Alongside this task he kept up his medical practice, and so learned in that precious period of ten years the reach and application of both the science and art of Medicine. He taught the *scientia* in the winter session and the clinical Medicine in the summer. He also devoted himself to pathology and the autopsy. In 1878 he was back in London at the feet of the great clinicians, Murchison, Gowers, and Gee—hard at work, learning, practising, preparing

himself for his own duties at McGill. He promptly took back his new experience and his revised methods to his classroom and laboratory at McGill. And so another five years passed; and in 1884 he is across the Atlantic again, this time at Leipzig, working at pathology with Weigert, and at clinical Medicine with Wagner—keen, diligent, enthusiastic, thorough, finding himself with a name and repute beginning to spread beyond the walls of Montreal.

One day at Leipzig, Osler received a letter inviting him to the Chair of Clinical Medicine in the University of Pennsylvania, a noble Quaker foundation in Philadelphia, then the premier medical school of America. He was asked to fill the post of Dr. William Pepper. 'I had played so many pranks on my friends' he wrote 'that when the letter came, I felt sure it was all a joke, so little did I think that I was one to be asked to succeed Dr. Pepper.' So the young Professor left Montreal, carrying with him his well-earned and substantial credit, and 'rich in the goods which neither rust nor moth have been able to corrupt—friendship, good fellowship, widened experience, fuller knowledge'. It was in 1753 and 1755 that Thomas and Richard Penn granted a charter for the establishment of 'the college, academy, and charitable school' which became in 1791 the University of Pennsylvania. The medical school itself was founded in 1765 by Dr. John Morgan, who had been a pupil of John Hunter in London, and of Cullen in Edinburgh, and had studied at Padua. Another of Cullen's pupils, Dr. William Shippen, joined Morgan and, together with Rush—and with the advice of Fothergill—they made the University of Pennsylvania a lineal descendant of the best British traditions. In this 'civitas hippocratica' at Philadelphia, Osler bent his energies to teaching work—by lectures, demonstrations, and ward instruction on the English model. He also established a clinical laboratory in association with the hospital,

and worked with Weir Mitchell on nervous diseases. But his sojourn here was soon to be completed, for on May 1st, 1889, he bid the University farewell. 'Nothing can blot out the memory of the happy days—rich in the priceless blessing of friends—I have spent in this city.' Just a week later he was received with open arms, 'and with the well-earned confidence of the profession throughout the entire land', as Professor of Medicine in the Johns Hopkins University in Baltimore, and physician to the Johns Hopkins Hospital.

IV

Though Osler's name was now well known in America, it was his wonderful work at Baltimore from 1889 to 1905 that gave him world-wide fame. Johns Hopkins, the Quaker founder of this University and Hospital, had in view the organization of an ideal medical school, and in this aim he was warmly supported by Francis T. King, Mary Elizabeth Garrett, and Dr. James Carey Thomas. The University was opened in 1876, a chair of pathology created in 1884, a chair of Medicine, first occupied by Osler, in 1889, and by 1893 the complete medical school was organized. Osler was therefore in a position to take a full share in the creation and planning of the medical school, and, accepting the Quaker principles laid down by the founders, he seized the opportunity of introducing the best medical traditions of Europe and America. It was a great occasion and he fully met it. The principles of this combined institution of university and hospital were announced by Francis King, Dr. John S. Billings, and Dr. Daniel Gilman (the President of the University) at the inauguration of the Hospital on May 7th, 1889. 'It is my special request' wrote Johns Hopkins in his Trust 'that the influence of religion shall be felt in and impressed upon the whole management of the Hospital; but I desire nevertheless

that the administration of the charity shall be undisturbed by sectarian influence, discipline, or control.' In the same letter he explained his bequest to be for the foundation of a hospital, for both rich and poor, which in structure and arrangement shall compare favourably with (that is, excel) any other hospital in America or Europe, and which shall ultimately form a part of the Medical School of the University. The hospital then, as such, was to be the last word in sound construction and scientific design. And so it was. But it was still more remarkable for its adaptation to the purposes of medical education: a large amphitheatre was provided for demonstration; tutorial rooms; residential accommodation for thirty senior students (*student practitioners*); a pathological laboratory for experimental research; a training school for hospital nurses; and a well-appointed out-patient department. This, then, was the setting in which Osler and his colleagues placed their conditions of an ideal medical education, in which they built for the first time a model medical school.

What were their conditions? First, they conceived that the essential thing was an effectual organization in units or departments, each in charge of a responsible head or chief, and over all a director. Osler's own department consisted of a medical unit with seventy beds, a large out-patient department, a clinical laboratory close to the wards, and a chief physician as director, who was to be also Professor of Medicine in the University. Under him there was a resident staff of first, second, and third assistant physicians (nominated by the Professor), a fourth in charge of the laboratory, and, lastly, four house physicians (to be elected annually) and a competent nursing staff. The out-patient section was in charge of a separate part-time medical staff, who had been assistants and were *now in practice*. Now this is a very important and interesting design, possessing vital features, the value of which was proved at Johns

Hopkins and is now being followed elsewhere. 'The Professor has three duties,' wrote Osler; 'to see that the patients are well treated, to investigate disease, and to teach students and nurses.' That is his philosophy of the professional life—to be an inseminator of other men's minds. Secondly, Osler laid down as an essential principle that the primary duty of such a clinical unit is the care of the patient, what he called the 'right spirit of a hospital'. The patients are not to be regarded as 'just so much material' but 'as our brethren, deserving, under all circumstances, every possible consideration and kindness'. That gentle courtesy came easily and naturally from Osler, and his object was to teach its practice as part of the educational course. His third principle was the organic relation between medical education and an effectual hospital service. But more than that he set out to show the true content of the hospital training of the student:

(1) The science of Medicine (anatomy, physiology, pharmacology, pathology) must be integrated with the diagnosis and treatment work of the hospital; in other words, science and not empiricism must be brought to the bedside, and the laboratory must be in the hospital. 'Every patient presents problems for research.'

(2) The clinical teaching must be individual, inductive, direct, and not didactic only—the student must himself do the work with his own eyes and his own hands—in the laboratory, in the classroom, and in the ward; the general clinic, lecture, or demonstration is ancillary to bedside study and not the central factor. 'My epitaph should be,' said Osler, long afterwards, 'He introduced routine bedside teaching into the United States.'

(3) The out-patient department must be an essential and organic part of the whole clinical training; it is the observation centre, and it catches disease at the beginning. Osler's systematic out-patient clinic became famous

all through America. It was the English method, but it was practised with thoroughness and on the grand scale.

At Johns Hopkins, Osler began to give full play to his literary faculty in relation to Medicine. It was there in 1892 he wrote his classical text-book on 'The Principles and Practice of Medicine', a standard book all over the world ever since. But he did more than that, he introduced literary study among his students. At Johns Hopkins a liberal and literary education was required as a condition of admission. The student was also set tasks of seeking information, not only in the body of the patient, but in the literature of Medicine. All this time Osler was in practice, travelling, reading, studying cases, learning, interpreting, attending his medical societies, always adding to his experience and enlarging his compass, and 'fertilizing' (that was his word) his students with ideas. Ah me! those were golden days; happy teacher, happy students.

It was in 1912 that I went, fortified with introductions from Osler, to visit the great medical schools of the North American Continent—McGill, Toronto, Harvard, Cornell, Columbia, Pennsylvania, Johns Hopkins, and the rest. It is not invidious for me to say that somehow in Montreal, Philadelphia, and Baltimore, I was sensible, in some special way, of the spirit of the teacher and friend who bade me go. There I saw his handiwork, there I met his disciples of the blood royal—Shepherd, John B. Garrett, Welch, Franklin Mall, Lewis, Howell, Whitridge Williams, Lewellys Barker, Meyer, Futcher, Hugh Young—and there I drank of that invigorating spring. The New World had equipped itself with new machinery, but there was something more than equipment and modern appliances. There was a spirit, deriving from the past, from Greek and Renaissance sources, looking forward to the future. I had been to the renowned

German Universities in the spring of the same year, and I was familiar with the Schools of London and Edinburgh, but here at Baltimore I found them all, the Edinburgh organization, the London hospital method, the German clinic—all combined together, all in unity, and all inspired by a lofty humanism and a noble ethic.

V

It was on a summer evening, at Oxford, in July, 1904, that I first met Professor Osler. It was a dinner party at Christ Church, and he replied to the toast of the guests. We had had some rather imperialistic glorification of the soldier, and Osler told us, quietly enough, that it was sentiment and the ideal which ruled the world, that the British genius was not really military or for conquest, but for settlement and home building, and that the great powers were in truth the unseen powers. It was perfectly done. That visit to England had its enduring influence—and it was the occasion of his accepting the chair of Regius Professor of Medicine at Oxford, and the fixed period at Johns Hopkins had come to an end. For me a very happy and stimulating friendship had begun.

The last lap, the fourteen years 1905 to 1919, of Osler's life added glory and lustre to his world-wide repute. It was a time of maturity, of settlement, of homeliness, and of immense influence. He followed in the footsteps of Henry Acland and Burdon Sanderson, and of Locke and Burton, of Erasmus and Linacre. As in Philadelphia and Baltimore, he became again the advocate of medical libraries, medical journals, medical societies, in order to fill life to the brim with medical learning and fellowship. He lived halcyon and happy days, revelling in Oxford —who took him to her heart—and in the supreme benediction of friendship, full of honour, a national possession. But it was not an idle life. He set to work

to build up the Medical School at Oxford, co-ordinating and integrating. The clinical teaching at the Radcliffe Infirmary and its close association with the science work going on in the University and with the local practitioners; the encouragement of the teaching of the history of Medicine as necessary to medical culture; the advancement of medical education itself, and the introduction of the unit system; active work as Master of the Ewelme Almshouses, as curator of the Bodleian Library, as delegate of the University Press, as president of the Bibliographical Society, at the Royal Society of Medicine, as a Radcliffe Trustee, and as Regius Professor; and in innumerable public services in London and all over the country—all this meant a very full life. He served on various official commissions, and his medical counsel was not infrequently sought by Government. He was the friend of every medical school in the kingdom, and the encourager of every medical society that cultivated fellowship or was in search of truth. The further education of the graduate claimed much of his time and attention. He poured himself out like wine. He was covered with honours, made a baronet at the coronation of King George V, received the honorary degree of D.Sc. from the Universities of Oxford, Cambridge, Dublin, Liverpool, and Leeds, the honorary degree of LL.D. from the Universities of McGill, Toronto, Yale, Harvard, Johns Hopkins, Aberdeen, and Edinburgh, the D.C.L. from Durham and Trinity, Toronto, and the M.D. from Christiania. He was a Fellow of many learned societies in all parts of the world, a Fellow of the Royal College of Physicians since 1883, and a Fellow of the Royal Society since 1898.

Sir William Osler married, in 1892, Grace, the eldest daughter of John Revere, of Boston, Mass., and widow of a distinguished colleague, Dr. Gross, of Philadelphia. Their only son was killed in France in 1917, a blow from which Sir William Osler never recovered.

VI

That is, in brief, the story of Osler's work, the externals of it, an inventory, a catalogue, the outer furnishment. But it is not Osler. For he was a *personality* whose work was but a fragment of himself—a strong, simple, sincere personality, radiant, hopeful, spiritual—a great interpreter, a true prophet, a dear friend. He was a man among men, combining love of humanity with love of craft, carrying always in his bosom a scroll of high thought and splendid vision, with a soul, alive and alert, looking out over the world, seeking a Quest. As was said of another Oxford teacher : ' He loved great things, and thought little of himself ; desiring neither fame nor influence, he won the devotion of men, and was a power in their lives ; and, seeking no disciples, he taught to many the greatness of the world and of man's mind.'

Now what is it that makes a great physician ? and how did this particular physician become what he became ? Clearly, the successful physician needs competent medical knowledge and skill ; sympathy and a large heart are also necessary ; and there must be wide and deep experience of disease, its beginnings and its end-results ; and lastly, there must be sound physique and good health to withstand the prolonged and exceptional strain of active medical practice. Osler, of course, had these four things in exceptional degree, and was thus, like a few others, a great physician. But when one comes to compare him with the famous doctors of the Renaissance, or of the seventeenth and eighteenth centuries, or even of the last fifty years, one sees at a glance that he was different. Not a great discoverer, nor pre-eminent in the laboratory or in any particular specialism, nor yet to be ranged with the giants, Leonardo da Vinci, Harvey, John Hunter, Thomas Young, Pasteur, or Lister, yet he had a unique place in the medical profession and outside it. He was something much more than the accomplished physician—more

pervading, influential, and cosmopolitan—he was something different from the supreme dividers of time.

There were, I think, two or three characteristics which made Osler what he was. First, he had an exceptional measure of the historical spirit and method. It expressed itself partly in literary form. He was, as he described Oliver Wendell Holmes, the successful combination of physician and man of letters. This literary habit began early with him in his devotion to Sir Thomas Browne and in his writing for the Canadian Medical Journals in 1872, and it continued all his life. The bibliography which was printed to celebrate his seventieth birthday contained 730 titles of books and papers written by him in the forty-seven years 1872–1919. His well-known text-book appeared in 1892, and before and after it there were dissertations of immense variety, on Sir Thomas Browne, Linacre, Servetus, Keats, Locke, Holmes, and other heroes, on science and immortality, on medical education in all its forms, on innumerable medical subjects and cases, on science and war, on the old humanities and the new science, and so on. His literary style was classical in flavour, often biographical or historical in subject, epigrammatic, comparative, sharpened by wit and sweetened by humour, always attractive and arresting, sometimes prophetic. He gathered together a splendid medical library, read widely, was almost a fierce book-lover, and had a retentive memory. Now this literary faculty facilitated the presentation as well as the transmission of his views. His *clientèle* of teachers and students, spread over forty-five years and four universities, was enormous, but it was exceeded by a greater company of witnesses, his readers, all the world over. He became the orator of Medicine and the encourager of literary Medicine in the Old World and the New. He advised medical students to read for half an hour daily outside their medical work, and suggested a ' bedside library ' of ten books—' the

close friends of inner education '—the Bible, Shakespeare, Montaigne, Plutarch's 'Lives', Marcus Aurelius, Epictetus, 'Religio Medici', 'Don Quixote', Emerson, and Oliver Wendell Holmes. But his historic faculty also expressed itself in a sense of proportion. It gave a characteristic maturity to his actions and conduct, it coloured and gave perspective to his outlook, it balanced his judgment. Thus his 'setting' was historical, and he lived—and he worked as if he lived—in a formative stage between a great past and a greater future, a witness to eternal continuity and progression. A single example of his proportional method may be quoted. In August, 1918, he lectured at Cambridge on the evolution of scientific Medicine in the United States. Here is a copy of his syllabus:

i. British Period to 1820

1. Medicine among the early colonists. 2. Influence of Edinburgh and of John Hunter. John Morgan and Benjamin Rush as types. 3. Rise of the Schools. Penna Hospital and Benjamin Franklin and John Fothergill. 4. The New England group as illustrated by Jacob Bigelow and James Jackson. 5. Medicine on the frontiers —E. McDowell and Daniel Drake.

ii. French Period, 1820–1860

1. The rise of modern clinical medicine. Laennec and Louis. 2. The differentiation of the fevers. 3. Experimental physiology. 4. 1846. Surgical anaesthesia, America's greatest gift to practical medicine.

iii. German Period, 1860–1890

1. Specialism and the Vienna School. 2. Virchow and Koch. 3. Traube and experimental medicine.

iv. American Period, 1890–

1. The Revolution in the Schools—Charles W. Eliot and William Pepper. 2. The Johns Hopkins Foundations,

D. C. Gilman, and John S. Billings. 3. Reorganization of Hospitals as integral parts of the University system. The unit and team work as illustrated in the cliniques of Cushing, of Halsted, and of the Mayo Bros. 4. The new era of preventive medicine. The Government departments. The Carnegie and Rockefeller Foundations.

Any Englishman who has tried to make head or tail of the history of American Medicine will find the case in a nutshell in this brief outline.

Then I should put Osler's wide experience as the second factor of his influence. 'I am a part of all that I have met,' he would often say, and he had met with many and much. In America and in Europe he had shared in all that was best in Medicine. An immense range of patients, many cities, many men, many books, had left their effect on a responsive and sensitive personality. He assimilated this extraordinary experience, and gathered it up, remembered it, and used it. No American and no European had this possession in similar degree. Toronto, Montreal, Philadelphia, Baltimore, Oxford, and the magic influence of Edinburgh, Berlin, Leipzig, Paris, and Vienna must be added, and, though he never lived there, he seemed always a citizen of London. He indeed could say with Ulysses:

> 'I am become a name;
> For always roaming with a hungry heart
> Much have I seen and known; cities of men
> And manners, climates, councils, governments,
> Myself not least, but honour'd of them all:
> I am a part of all that I have met;
> Yet all experience is an arch wherethro'
> Gleams that untravelled world.'

Finally, there was his wonderful personality. He was Mr. Great-heart, loving persons rather than things, full

of sympathy, tenderness, appreciation; loving, in particular, youth and beauty—beautiful thoughts, human beauty, the beauty of nature and art, Pasteur's 'un idéal de beauté—idéal de l'art, idéal de la science, idéal de la patrie, idéal des vertus de l'Évangile'. That was Osler's also, mind and heart according well, making one music as before, but vaster; and this union of heart and mind made the interests of others his own, and gave harmony to every touch of his lyre. I remember one day we were discussing a mutual friend whom we found rather trying, and Osler said, 'Well, you see he had not the advantage of choosing his parents,' adding with gentle slyness, 'as you and I had.' In the presence of hostile criticisms of persons he would select for praise the redeeming features, or touch the fault with its saving grace, or in the last resort would fall back on *tout comprendre c'est tout pardonner*. This graciousness naturally did not always go with the austerity of Mr. Valiant-for-the-truth, and sometimes it led to a certain degree of elusiveness and escape. Hard and rough business, fierce battle, the firm severity, prompt execution in difficult situations—these were not, in later life at least, Osler's sphere. But his gentleness with his friends, his pervading humour and gladness of heart, and his consideration for his patients, was very much his own country. I have seen him with patients, rich and poor, and he was something wonderful, a word, a touch, a smile, all of it a little the gentler with the needy. And as for us, his friends, no word or music can ever tell of the sweetness and humour of his companionship. I have a sacred grove for my medical heroes, a sort of spiritual *Valhalla*, and there you will find Pasteur, Lister, Paget, Hutchinson, and there must now go the youthful-hearted, gay, and charming Osler.

These were some of the things that made Sir William Osler so great a man—that gave him his large heart and

his wise understanding and his beautiful soul, and made him, all down through the long length of his sunny life, a Healer and an Encourager of the children of men. My fragment of testimony is a broken one, but I can make it whole, and beautify and enrich it, by adding two quotations, one from his dear friend and 'brother' Regius Professor at Cambridge, and one from himself. Sir Clifford Allbutt was asked on behalf of his friends to present to Osler a Collection of Essays in celebration of his seventieth birthday, and he sent him a dedicatory letter, which was as follows:

'My Dear Colleague,—The stealthy foot of time carries us from youth to age so imperceptibly that we are hardly aware of the change; insensibly we shorten our arms, husband our strength, and are willing to think our prowess undiminished. Yet men have not refrained from marking the lapse of time by signal days, and months, and years; often by celebration of those whose lives have been devoted to the good of their kind, often by memorials of joy and achievement, or again of bitter and unforgotten sorrow.

'And, as for the nation or the race, so in his own life, are there for each of us memorable days of sympathy in joy and sorrow. One day of sympathy in joy was that in the summer of 1904 when some of us were gathered around the hospitable hearth of Sir John and Lady Burdon Sanderson, and, as suddenly, I believe, to you as to the others of us, like a flash of light the thought was born, how one scarcely knew, that you might surrender your great functions at Baltimore to enter upon a new life at Oxford.

'Ever in the heart of the folk of the New World lies warm and deep the kinship with the old home; thus, almost with the rapidity of thought, between Canada, the United States, and Great Britain, an academic link threefold was forged. In no person so well as in your

own could this unity have been so happily consummated; you arrived indeed from overseas; but as a pilgrim child of Oxford. In you the literary and historical tradition of the beautiful city was united with the zeal and adventure of the New World; so that in winning you for Oxford, and for Cambridge and Great Britain, we did no robbery to Baltimore and Montreal.

'Since that day we have shared, in our degrees, your happiness and your sadness; we have rejoiced in your honours, and on this day when you reach the limit that the men of old regarded as the last ripeness of a man's life, I, your brother Regius Professor, am permitted to offer you as a tribute of our admiration and affection from both worlds, our little horn, if not of plenty, yet the best of our garden. Your "radical humours contain more than sufficient Oyl for seventy years"; oyl enough to keep your lamp trimmed and bright till the Old World, now tardily procreant, be brought again to the birth. Meanwhile in good days or evil you can thankfully say after our great example, "My Father works hitherto and I work".

'Affectionately yours,

'C. A.'

Is not that a beautiful thing? It is the flower of a rich and ripe friendship which has done much for English Medicine. The quotation from Osler himself is a sentence from his speech in May, 1905, at the farewell dinner of the medical profession of America and Canada, when Osler was bound for Oxford:

'I have had three personal ideals. One, to do the day's work well and not to bother about to-morrow. The second ideal has been to act the Golden Rule, as far as in me lay, towards my professional brethren and towards the patients committed to my care. And the third has been to cultivate such a measure of equanimity as would

enable me to bear success with humiliation, the affection of my friends without pride, and to be ready when the day of sorrow and grief came to meet it with the courage befitting a man.'

VII

I do not wonder that men and women all over the world felt forlorn and orphaned when they learned that this brilliant, affectionate, and unselfish man had left us, and that, incredible as it seems, we shall hear his voice and see his face no more. Tired and worn, he laid down his task, in the peace of his own roof, at sunset, at the end of the year. His Confession of Faith was belief in the Inward Light for to-day, and the larger life for to-morrow. Thus he passes—a courageous, buoyant, life-giving, trustful friend of mankind—to some place which, in the old Greek word, has happiness as well as beauty, to some abiding temple of fame where the immortals dwell, to 'that strand of the Daughters of the Sunset' of which Euripides sang long ago in the golden age,

> 'Where a sound of living waters never ceaseth
> In God's quiet garden by the Sea.'

8. Modern Interpreters

FIFTY YEARS' PROGRESS IN PUBLIC HEALTH

¶ *An Address as President of the Section of Preventive Medicine at the Annual Congress of The Royal Sanitary Institute at Edinburgh*, 1925.

FIFTY YEARS' PROGRESS IN PUBLIC HEALTH

THIS meeting of the Royal Sanitary Institute celebrates the Jubilee of the great Public Health Act, which passed Parliament in July of 1875, and though this Conference has for consideration some urgent and deeply interesting questions of modern methods of Preventive Medicine, I venture to think we shall do well to ponder for a few minutes upon some of the first principles of our work.

The Origins of the Public Health Act of 1875

Let us consider the forces which led to the Public Health Act of 1875, for they may be found to cast light on the path of the future. And first there is a general influence at work. Redlich has drawn attention to 'the working of a hidden law of politics, a law of universal operation, but at no time of place more evident than in the recent history of England. Each success of the democracy in widening the Parliamentary franchise has been closely followed by a period of administrative reform, during which democratic ideas are transferred from the formal sphere of political rights into the actual service of the State and the practical work of government. Hence the thoroughly organic character of English democracy.' There have been four great extensions of the franchise. Thus the enfranchisement of 1832 was followed by the reform of the Poor Law, and of borough government in England and Scotland, by slavery abolition, and by an extended Factory Act. The enfranchisement of the town labourer in 1867 was followed by Gladstone's first ministry, from which was demanded religious equality, educational opportunity, reform of the Civil Service, and the army, and the formulation and establishment of a national policy in public health.

The Reform Act of 1884, extending the franchise to agricultural labourers, was followed by the fundamental Local Government Acts of 1888 and 1894. The former created the County Councils, and the latter made Urban and Rural District Councils popularly elected bodies charged with health services under central control. In 1918 came the Representation of the People Act, which nearly trebled the number of Parliamentary voters, and included women. It remains to be seen what the results will be. Early aspirations for reform were checked by the need for drastic economy, but already insurance, housing, old age pensions, and public health have made insistent claims. So, first among the forces which produced public health reform must be placed the democratic and social aspiration of the people.

This aspiration had its source in discontent and alarm. The English people became discontented with the disease and despair which followed in the train of the industrial revolution, with grinding poverty, with the labour exploitation of women and children, and, after the middle of the century, with the cruelty and waste of the Crimean War; and they became alarmed at the ravages of the cholera and of small-pox. It was Chadwick's monumental 'survey' into the sanitary condition of the people in 1842, his *magnum opus*, which led to the Royal Commission on the health of towns, and ultimately the Public Health Act of 1848. This last great effort of Chadwick had its source in his work first as a Poor Law Commissioner, and then as Secretary of the Poor Law Commission. Our public health service is the direct offspring of the original Poor Law service, and sprang out of the fuller appreciation of the close relationship between the *life* and *occupation* of the poor, and their disease and early mortality. Such was the ground of their discontent. But alarm also played its part. For the ravages of cholera in its four principal invasions of this country in 1831, 1848, 1853, and 1866, had proved a

solemn warning to all men that, unless greater attention was given to sanitation, the country was unsafe. This feeling was increased by the epidemic of small-pox in 1871–1872.

There was yet another influence which led to action, and that was the influence of Bentham upon Chadwick and of Owen, Cobbett, and the Chartists on the leaders of public opinion. Bentham not only indoctrinated his disciples with a utilitarian philosophy and the 'sanitary idea', but he indicated both the sound methods of enquiry and the correct formulation of the draft of the necessary Bills. He was a modern interpreter.

Lastly, there was being provided by Parliamentary Committees, Commissions, and individual investigators, an enormous volume of medical evidence as to the poor physical condition of the people and the means of prevention or remedy. Thackrah produced his book on the effect of occupation on health in 1831. The Poor Law Commissioners drew public attention to preventable disease as a cause of pauperism. Arnott, Kay, Southwood Smith, and Greenhow were turning out their stimulating reports on the incidence of disease. An excellent example may be found in the famous report to the City of Edinburgh in 1865 by Sir Henry Littlejohn. Simon began his series of reports on the distribution of disease in England in 1859, and in his eleventh report to the Privy Council, in 1868, his proposals for consolidation of public health law were set out. The chaos and 'formlessness' of the sanitary law then current was, in his view, the explanation of its ineffectiveness. Above all, in 1841, began the cold and certain stream of vital statistics by Farr, which for a wonderful series of years brought conviction to the mind of Parliament.

The New Influences after 1875

When we come to analyse these secular changes and movements we shall find that the two ideas which stirred

men's minds, and which culminated in the great Public Health Act of 1875, were *utilitarianism* and the effect of *environment*. They were not only ideas which were postulated, but the value of them at that particular time was actually proved before men's eyes. They became established, not as doctrines only, but as practice. They continued to play a significant part in the next half century, and they must always remain potential forces in public health action. New times have brought new applications of them, because of new knowledge, but the last fifty years have proved themselves a golden age of Medicine, with which no previous similar period in the history of man can compare, and they have laid some new foundations of Preventive Medicine. Let us consider three points by way of illustration. The first is *Infection*. The modern history of infection is usually dated from Fracastorius of Padua in the sixteenth century, and Athanasius Kircher in the seventeenth. But the proofs and agents of infection were only ascertained within the last fifty years, and principally by the epoch-making work of Pasteur, Koch, and their disciples. Two years after the passing of the Public Health Act of 1875, Pasteur had proved transmission of disease by infective virus, and Koch was already at work on the manufacture of solid culture media, a laboratory method which made possible many investigations. In the one generation thus begun we had the discovery of the bacterial cause of a dozen of the great diseases—actinomycosis, gonorrhoea, typhoid, suppuration, tuberculosis, glanders, cholera, diphtheria, tetanus, rabies, Malta fever, and plague. Before half of that amazing twenty-five years had passed we had in our hands, for prophylactic and therapeutic use, the anti-toxins of anthrax, diphtheria, and tetanus; and they were quickly followed by anti-typhoid and anti-cholera sera. It is now twenty years since we knew both the cause and cure of syphilis, and forty-five since the general introduction of antiseptic surgery. It is this

glorious chapter of quest and conquest which moved the centre of gravity from environment to infection, and not only to the agents of infection, but to the conditions of person and environment, the lack of resistance, which favoured those agents. There had been 200 years' study of the outward circumstances and characteristics of epidemic disease since Thomas Sydenham had permeated English Medicine with the value of clinical field observation, and John Graunt, the Cornhill draper, had laid the foundation of vital statistics. Simon and his investigators became the modern prototype of Sydenham, and Farr and his successors of Graunt. But it was the new ideas of infection which gave meaning to the methods of the public health service. Pure water-supplies, effective sewerage, removal of refuse, fresh air, wholesome milk and other foods, the reduction of overcrowding, clean streets and dwelling houses, and epidemic regulations, which were the principal items in the grand inventory of the Royal Commission of 1869, became not less, but more, important. They acquired a new meaning and a new vitality, even as the infectious patient as a germ distributor called for new organization of isolation, disinfection, and treatment.

Alongside the study of Infection, and concurrently with the opening of the new book of pathology, there was a rapidly growing knowledge and sense of *Physiology*. Sir Michael Foster has told us in his History of Physiology how exact knowledge of the functioning of the body arose. But his story does not include the nineteenth century, which gave us Muller, Ludwig, Schwann, Claude Bernard, and the new school of British physiologists. It was an Edinburgh graduate, Sharpey, who became the father of that school, and his followers included Huxley, Burdon Sanderson, Foster, Schafer, Bayliss, and Sherrington. The expanding knowledge of physiology in the last fifty years is exerting an effect on the whole outlook of Preventive Medicine. Fresh light has been

shed on the blood and its circulation, and the relation to it of respiration, the purposive integration of the central nervous system, the nervous regulation of the body, the chemical regulation of function, endocrinology (hormones), biochemistry (vitamins), and standards and norms both of capacity and of resistance. Something of the interpretation of this new knowledge has entered into the common possession of men, and the results have been twofold. First, it is now known that the chief defence against disease is not changed environment, *but the body of man*; secondly, that obedience to the laws of physiology is necessary both for the maintenance of the body in health and for its full capacity and effective use. These are two very simple yet revolutionary and far-reaching conceptions, and they make the subject of physiology in its widest meaning, not only the principal subject of the medical curriculum, but of primary and vital concern in regard to the efficiency of the whole nation. For, observe what is happening. The last half century, as we have seen, has brought fuller knowledge of pathology and of infection to the expert, but it has brought the elements of practical physiology into the life of millions. The food of the people has undergone a change for the better—it is more nutritious and more varied—meat, fruits, vegetables, fats, sugars; the importance of fresh, cool, moving air is widely accepted and more largely secured; sunlight is appreciated and less shut out, indeed, every day it is more applied and even harnessed to man's benefit; water is more used for body cleanliness, in millions of gallons daily, as compared with two generations ago; regular physical exercise is recognized as essential to health and has become for every child an integral part of the school curriculum; adolescence is trained, as a matter of economics, to gauge its capacity for work, both mental and manual; the body faculties are measured, its output assessed, its fatigue avoided; even error and crime are adjudicated on a psychological

basis; the physiology of reproduction has become the talk of the town, and child-birth is no longer looked upon as a morbid condition; the physical condition of every schoolchild is supervised under statute; and there is a wholly new understanding of personal hygiene. Of course, in all these directions there is still much ignorance to overcome, but the change which has passed over us is profound.

There is a third aspect of our problem to bear in mind. Whilst during the last fifty years the Industrial Revolution has continued—and it is well to remember that it is still in progress though different in form—we have been living in a period of remarkable *Social Emancipation*. Twice within that time there has been extension of the franchise and seventeen million people now have the Parliamentary vote, including seven million women. Wages have risen, relatively and absolutely, hours of labour have been reduced, and conditions of labour have been greatly improved. This has entailed, and perhaps encouraged, increased claims on the State. The service of the individual to the State during the European war stimulated a reciprocal contribution from the State to the individual, and the pendulum has swung a long way in a short period of time. Then, in 1870, came the Education Act, and we are now reaping its harvest, and are hungry for more. The intellectual aspirations of the people do not indeed pursue the ordinary lines of elementary education, but, nevertheless, there is desire to know. The enormous development and use of the Press, of cheap literature, of cinemas, and of 'wireless', are unmistakable indications; and social evolution and practical psychology in various unprescribed unorthodox forms are advancing apace. Accompanying these two changes of emancipation and education, and in part resulting from them, has been a rapidly rising standard of comfort. The English people are now vastly more intercommunicable; they are happily living more in the

open air and sharing more widely in games and sports; they are better and more suitably dressed and fed; they are practising sobriety, though insufficiently; they are cultivating their leisure (at the rather high cost of diminished production, which, if we are to advance, it is imperative to increase); on the whole, there is a wide understanding of the importance and advantage of personal health which, in 1875, was appreciated by the few.

Now these characteristics of the period under consideration—utilitarianism, sanitary environment, infection, physiology, and social emancipation—have altered the whole outlook for Preventive Medicine. They have exerted an active influence on the period itself, and are likely to achieve even more in the immediate future. The use of anaesthesia, antiseptics, and various physico-therapeutic methods has revolutionized Surgery; the applications of the new physiology and pathology have expanded Medicine. In the body politic both have found expression in the ever-widening adoption of public medical services. The hospital system, the Poor Law service, and factory inspection began long before 1875; concurrently with their development the State has since embarked upon a public health service (including an organized attack on infectious disease, tuberculosis, and venereal disease, provision of municipal midwives, and maternity and child welfare service), and there have come into existence a school medical service, a health insurance system, and a national scheme of medical research.

The Results of these Reforms

Looking back from 1925, we may well ask: What has been the result? Well, first there has been a decline in the death-rate. In 1871–1880 it was 21 per thousand persons living, and in 1924 it was 12; in the same period the

infant mortality rate, a most sensitive index of national health, was brought down from 149 per thousand born to 75. Expressed in another way, the expectation of life for every child born in Britain to-day is approximately twelve years longer than that of its grandfather when he was born.

Then, in the second place, there has been a reduction in sickness and invalidity from certain diseases. In 1875 *enteric fever* accounted for 370 deaths in each million, last year the 370 had fallen to twelve. Its incidence in the South African War was 28.5 per cent of troops, in the European war, 1 per cent. In 1875 there were 1,500 deaths attributed to *typhus* in England and Wales (which had been differentiated from enteric in 1850); in 1924 there were only five. But 100 years ago, in London and Edinburgh, typhus was endemic, with periodic epidemic outbursts. 'The disappearance of typhus and relapsing fevers from the observation of all but a few medical practitioners in England, Scotland, and Ireland' says Creighton 'is one of the most certain and most striking facts in our epidemiology', and he attributes their disappearance to better housing, cheap food, and increased wages. The *tuberculosis* death-rate is declining rapidly and with increasing velocity. In 1847 the death-rate per million from consumption was 3,189, in 1875 it was 2,313, and in 1924 it had fallen to 801. It is hardly too much to say that if this decline should continue more or less along the line it has followed, tuberculosis will have become a rare disease before the end of the present century. S*mall-pox* was a national scourge a century ago; to-day it is the perquisite of those who prefer to have it. In 1924 Sir Clifford Allbutt declared that the almost complete abolition of *chlorotic anaemia* of young women is one of the most remarkable issues of a single generation of modern Preventive Medicine. All this has meant an immense saving of human life, an increase of human capacity and national wealth, an

incalculable extension and enlargement of happiness and contentment.

But there is another epoch-making effect. The Preventive Medicine of fifty years has, in the words of Rudyard Kipling,

> 'Smote for us a pathway
> To the ends of all the earth.'

In some ways the most wonderful medical triumph of the past half century has been the discovery of the means of *the control of the Tropics*. It is true that we are yet a long way off complete control, but the causes of disease have been found and the means of stamping them out demonstrated. *Famine* stands in the front line of the captains of the men of death—and the advance in methods of irrigation and transport of food have greatly reduced it and played a prominent part in the establishment of public health. Close behind famine follows disease. The discovery of the causes of malaria, of yellow fever, of plague, of cholera, and of sleeping sickness, is common knowledge. Yet all these discoveries belong to the period since the Public Health Act of 1875.

Sir Malcolm Watson demonstrated the possibility of preventing *malaria* in the Federated Malay States by banishing the anopheles' breeding-places by the clearance of the coastal forest, and subsoil and surface drainage. In India and elsewhere this technique may prove inexpedient or insufficient, unless supplemented by a direct attack on the mosquito in its larval or adult stage, or screening habitations or persons from its invasion, or treating cases or carriers. Indeed, the recent Malaria Commission of the League of Nations in Italy, Russia, and Eastern Europe, has recommended for countries with incomplete public health services and limited funds, the urgent necessity of abstaining from 'radical' engineering measures and adopting 'primary' public health measures of ascertainment of infection, treatment, and

after-treatment of patients and carriers, and dealing directly with infected houses and mosquitoes—in a word, quinine, the attack on the mosquito, the protection of the individual, and general sanitation.

The work of Gorgas in stamping out *yellow fever* in Havannah and on the Panama Isthmus is well known. By a strict discipline of quarantine, hospital isolation, drainage, sanitation, and mosquito screening and destruction, he was able to eliminate this disease, even though an immigration of non-immune population was continually occurring.

Practical measures against *sleeping sickness* (trypanosomiasis) have been taken effectually in the Cameroons, the Congo, Tanganyika, Kenya, and Uganda. They consist of the systematic surveys (clinical and bacteriological) of the infected population followed by curative and prophylactic use of atoxyl in large doses ; the separation of the healthy from the infected, with the isolation, if necessary, of whole villages or the migration of sections of the population from areas or streams affected with the tsetse fly ; sanitation of villages and improvement of diet ; the clearance of banks of water-courses, paths, roads, and settlements of all brushwood, and their proper drainage ; and lastly, fly destruction by means of bird lime or otherwise. These methods have completely suppressed sleeping sickness in the Portuguese Island of Principe, off the west coast of Africa, and proved effective in terminating recent disastrous epidemics on Lake Victoria Nyanza, and elsewhere in Equatorial Africa. In this way hundreds of thousands of lives have been saved and the way in which the Tropics can be brought under control has been demonstrated. This problem of tsetse fly is, in the opinion of the East African Commission (1925), 'probably the most serious threat to the population in our East African territories. . . . We regard the tsetse domination as constituting a menace, not merely to East Africa, but to all those countries

which look to East Africa as the source of supply of food and raw materials '.

All this can mean only one thing. The last half century has proved beyond doubt that, nationally and imperially, Preventive Medicine has now become practical politics. The trail has been blazed. It remains for this country to use it, apply it, and extend it—and all of it—with courage and wisdom, to its national and imperial problems as the sound and economic policy. A stunt here, and a stunt there, will not suffice—it should be organized as a whole, as an integral factor in state-craft.

The Future

Let us turn to the future. Much remains to be done. For whilst progress has overcome many diseases, others remain prevalent and destructive. In 1924, in England and Wales, respiratory diseases caused 82,000 deaths; diseases of the heart and circulation 79,000; cancer 50,000; nervous diseases 47,000; tuberculosis 41,000; and influenza 19,000. These are very formidable enemies, responsible for 65 per cent. of our mortality, and we cannot yet defeat them. We still lose nearly 3,000 mothers in child-birth, and more than 50,000 infants before they have completed their first year, and in both categories the maimed far outnumber the dead. We still have 40 per cent. of the deaths occurring under 50 years of age. In 1924 the sickness among insured persons only, entailed more than 23 million weeks of lost work, equivalent to 447,000 years, or to 447,000 persons off work for a year. It is a very serious, and largely a preventable, drain upon national resources, costly and wasteful in many ways; much more costly and wasteful in lost time than that of all the industrial disputes put together. In a word, national ill-health loses time and reduces production, as well as resulting in suffering, discontent, and premature death.

The history of the evolution of our system of Public Health since 1875 and its effects reveal, as we have seen, some of the chief influences which have played a predominant part. We must continue to be utilitarian in the best sense of the term. We must also be more economical. Our financial resources must be husbanded and our revenue not mis-spent or frittered away. I am convinced that the ratepayer is reasonable when he asks for equally good results at less total cost. In fact, it is now a national necessity that money must be saved and not wasted; production must be increased and not diminished; personal responsibility stimulated and not weakened.

But the past teaches us we must still build upon a sanitary foundation; we must, like Harvey, 'search and study out the secrets of Nature by way of experiment', and by research learn more of the hidden paths of infective processes; we must teach and practise physiology; and, above all, we must understand the social habits, aspirations, and psychology of the people. Yet for public practitioners of the science and art of Preventive Medicine, all this is not enough; it is not close enough down to the business we have in hand. These high things must be harnessed in the statesmanship and technique of health administration, and there seem to me to be three main lines along which there is urgent need to advance.

(i) *A New Local Unit of Sanitary Government*

The present system of local health government in England is like an Egyptian palimpsest, composed of several layers of design lying one upon the other. At the bottom there are the Poor Law Unions, next above them and three times more numerous are the Local Sanitary Authorities, superimposed upon which come the Local Education Authorities (318), then the Insurance Committees, numbering 145. Thus the whole country

is mapped out four times over, but the charting has been done by different hands, at different times, and for different purposes, and hence arises duplication, overlapping, and confusion. There is confusion in areas and authorities, but there is no less confusion in the family. There are four local authorities concerned with maternity and infancy; three with children of school age; five authorities deal with persons of unsound mind or mental deficiency; four authorities are concerned with 'sick persons'; three with the aged poor; and four with the able-bodied poor. It is all anomalous, extravagant, and redundant, with a result which is relatively ineffective and financially wasteful.

What we seem to need is, first, *a single unit of health government* with necessary sub-committees for particular purposes. The principles which should guide us in devising such a local authority are (*a*) the concentration, as far as practicable, in one authority in each area, of the responsibility for all administration of health services from local rates, with or without Exchequer grant in aid; (*b*) the association of the work of the poor law and Insurance with the public health service, and the use by that service for the whole community of co-ordinated medical institutions, both voluntary and municipal; and (*c*) the unification in appropriate committees of the local authority of all public medical provision for the sick and infirm of all ages. Clearly, there would be advantage in thus having one authority for all health purposes—and towards unification of this nature many are looking. But the question is large and complex, and there are many considerations to which regard must be paid in prescribing a unit of sanitary government, including its history, size, population, urbanization, character of industry and society, intercommunication, rating, relation to local and central government, and so forth. If a large local unit be contemplated, it would be necessary to provide for the encouragement of a consciousness of

community of interest and aim in the smaller contributory or constituent divisions, with appropriate delegation of powers or functions in accordance with services to be rendered. The large autonomous body might in that way delegate some of the actual detail work to the more local bodies.

There is a second, somewhat similar, common-sense requirement, namely, *uniformity of administration*, in all comparable areas. All through the country, and in all departments of State Medicine, there is need for introduction of accepted standards, and a larger measure of equalization and uniformity of central and local action, yet with ample opportunity for variety dependent on local needs and circumstances. There remains a third principle which the profession must not allow itself to forget, namely, that the local unit of health government must be *representative* of the will of the people as a whole. It cannot be wholly medical in personnel or in purpose. It must be comprehensive and disinterested. 'Our trade our politics' is never sound state-craft.

Now, in devising this reform, the medical profession must, in the interest of the State, not less than the profession, take their share, exchanging with the layman their views on many points—the nature of the authority, its membership, the question of the co-option of experts, finance, medical participation, the respective functioning of the different local committees, the use and adaptation of existing institutions, and their economical arrangement, and the place and character of the domiciliary medical services.

The present scheme of local sanitary authorities was conceived as far back as the Royal Sanitary Commisssion of 1843, was actually recommended by the Commission of 1869, and legislated for in the Public Health Act of 1872, which established as many as 1,539 local sanitary authorities in England and Wales. Experience in health administration and other forms of governance have

proved the grave disadvantages of small units of local government, and the trend has been to enlarge them. The Poor Law Amendment Act of 1834 reduced the units of poor law administration from 16,500 to 660; the Education Act of 1902 reduced the unit of education administration from 2,469 School Boards, to 318 local education authorities; the new Rating and Valuation Bill would reduce the units of local rating from 12,882 to 648. These reductions unquestionably make for efficiency and economy. The next step, and of its urgency there is general agreement, is to reduce the 1,900 Local Health Authorities, in a similar drastic way, co-ordinating the duties of the smaller ones with those of the larger ones. We must not forget that the present scheme of local sanitary authorities (now 50 years old) has rendered great pioneer service and has given sanitation an invaluable local setting. But under modern conditions the disadvantages are overwhelming. In the smaller bodies there is all too often incompetency both of personnel and officers, combined with inadequacy of remuneration of the officers; there is duplication of officers and institutions leading to extravangaces, waste, and confusion; local and personal considerations predominate, with the result that self-interest is cultivated, vested interest created, and public interest neglected; and there is lack of uniformity and equality in the administration of sanitary law common to the whole State. Yet epidemic disease is not confined by parochial boundaries, e.g. it is impossible to grapple with smallpox or typhoid fever if one small area differs from another in the practice or neglect of essential methods. Water-supply, sewerage, river pollution, and hospital provision must also be dealt with on a general, and not a particular, scale. It is true, of course, that these features are characteristic of some of the smaller authorities only, but these smaller authorities are upwards of 1,000 in number, and their disabilities are injuriously affecting

the entire public health service of the nation. There are 1,455 posts of Medical Officer of Health, but only 350 of them are whole-time, so that 1,100 Medical Officers of Health are also medical practitioners who, with all their good will, can only devote part of their time and energy to the public health service. Efficiency which is dependent upon the effect of divided loyalties or personal good nature can never be efficiency. In fact it can only be, as Sir Lyon Playfair told the House of Commons in 1888, 'desperately inefficient'. 'Wise men' said Sir John Simon long ago 'will not expect that a great national reform shall be achieved by casualties of good nature.'

(ii) *Effective Co-ordination of Medical Services*

I suggest that the second step in the future reform is the effective bringing together in each sanitary area of the various branches or forms of public medical service in such a way as to make them work as one connected and co-operative scheme. In science, as in war or in football, team work is the condition of success. We must not only build on the foundations of others, but join hands with our own contemporaries. We have seen that historically the existing public medical services are the hospital, the poor law, factory supervision, the public health service (sanitary environment, infectious diseases, food supply, and maternity), the school medical service, and National Health Insurance. The problem of the complete physical supervision of a people is thus met or nearly met. Maternity, infancy, the schoolchild, the worker, the insured person; poverty, sickness, and old age; and all through life the essentials of a healthy environment—these things are now all separately provided for. But there are three significant defects. First, the provision made is as yet incomplete and inadequate; secondly, no effective organization exists for children between infancy and school age, or for adolescents from

14 to 16 years of age (between the end of school life and the beginning of insurance); and, thirdly, though we have six public medical services, there is not a sanitary area in the country in which we are at present getting full inter-co-ordination or even uniformity of administration. There is far too much of the water-tight compartment, and too many different authorities working the services. Yet until there is linking up and concentration of all forces on the focal point it is idle to expect full effect. Though we have in England and Wales upwards of 3,400 hospital institutions with 350,000 beds, there is but little correlation between poor law, isolation, voluntary, or special diseases hospitals. Yet in each district there should be close association between voluntary and State institutions. Though the poor law is now so largely medical, it is still administered on a relief basis, and by bodies which are not health authorities. The factory service and the school medical service are still insufficiently connected with the local work of the sanitary authority; and, above all, there is much to be done to give health insurance its rightful place as an integral factor in Preventive Medicine.

The great triumphs of public health work in the last century were for the most part won in the field of environmental hygiene, and it must always remain our foundation. With the new century, however, there came a remarkable development. A direct frontal attack was made upon tuberculosis, a comprehensive system of school hygiene was introduced and rapidly developed, maternity and child welfare work was widely undertaken, the new knowledge of the diagnosis and treatment of venereal disease was applied gratuitously for the alleviation of sufferers all over the country, and by the establishment of the Insurance Medical Service the State made the family doctor an integral part of our system of public health administration. It may well be that from a public health point of view it would have

been more convenient if poor law reform had preceded the establishment of National Health Insurance, and if the latter had been anchored in a reorganized local authority closely associated with clinics and hospital institutions. But there it is, in Britain we are not deductive philosophers, and we proceed 'to take occasion by the hand'.

> 'A land of settled government,
> A land of just and old renown,
> Where Freedom slowly broadens down
> From precedent to precedent.'

The fundamental fact and common ground is this, that we have in Great Britain 15,000 insurance practitioners who have entered the service of the State to care for the health of upwards of 14,000,000 insured persons in the interest of Preventive Medicine in its broadest meaning. The reform which our forerunners desired has come to pass, the workers have ready access to the doctor at the earliest stage of disease, with the result that the medical supervision of them is actually threefold greater than before the Insurance Act was passed. There is more careful diagnosis; there is earlier treatment; there is better knowledge of the incidence and distribution of disease, and at a stage when it can be cured or prevented; there is, for the first time, a measurement of the relation between sickness and capacity to work. No doubt there are still many defects and inequalities in the administration of so novel a scheme. But the scheme is here; and it is for us all to make it work by integrating it with the other public medical services. If in every district medical practitioners and the Medical Officer of Health will co-operate cordially an immeasurable advance will be made forthwith.

(iii) *Public Education in Health*

The third reform which is needed seems to be proceeding apace, namely, the education of the people in

hygiene. One thing is quite certain. We have reached a stage in the evolution of the public health when it is a necessity of further progress that we should create an enlightened public opinion, and carry it with us. This is necessary, first, because there is need of an ' impulse ' behind sanitary legislation and effective administration of it, and, secondly, because the public health is dependent upon personal hygiene and the day by day individual practice of the principles of Preventive Medicine. *We must all become its interpreters.*

The local authorities are indirectly engaged in educational health work in so far as they discharge effectually their statutory duties under the Public Health Acts, and this aspect of their work is exerting, as a study of the history of the past fifty years will show, a paramount influence on the community. It is, on the whole, the most effective and far-reaching form of health education. Some local authorities and many voluntary societies are undertaking supplementary educational work of a more direct nature.

As we are evidently on the brink of a widening system of popular health instruction, I may express the considered opinion that it is the local authorities who should be mainly responsible for undertaking systematic educational health work, direct as well as indirect, suitable to their own district, circumstances, and needs, with such supplementary assistance as the voluntary societies concerned may find themselves able to furnish.

It is important that information thus afforded should be appropriate, correct, and timely. Some medical knowledge should be imparted, some knowledge of the ways and means of sanitary government, and much advice as to personal hygiene—but not one of these three should be overloaded. Exceptional facilities now exist, and the people should be encouraged to use them. Instruction should be given as to the effect of social habits and conditions on health, and *that it is won by a way of life*

rather than a bottle of medicine. Above all, we must all learn to think of public health, not only in terms of the individual, the home, or the parish, but nationally, imperially, and even internationally. The world is both larger and smaller than in 1875, and the capacities and opportunities of human life and endeavour have been greatly and hopefully expanded.

9. Future Interpreters

EVERYMAN IN PREVENTIVE MEDICINE

¶ *An Address as President of the Section of Sanitary Science and Preventive Medicine at the Jubilee Congress of the Royal Sanitary Institute, held at the Central Buildings, Westminster*, 1926.

EVERYMAN IN PREVENTIVE MEDICINE

> Knowledge and Wisdom, far from being one,
> Have oft-times no connection. Knowledge dwells
> In heads replete with thoughts of other men;
> Wisdom in minds attentive to their own.
> Knowledge,
> The mere materials with which Wisdom builds.
> . . . . .
> Knowledge is proud that he has learn'd so much;
> Wisdom is humble that he knows no more.
>
> COWPER, *The Task*, 1784.

THE celebration of the Jubilee of the Royal Sanitary Institute reminds us of the landmarks in the history and philosophy of sanitary science in England. We learn, with Emerson, to put the meaning of the years against the meaning of the days and hours. We see that it was the necessity of reform which called into being this institution.[1] We understand the value of its broad and solid foundation, which comprehended several professions and interests in one purpose and which utilized and directed public opinion to one end.

The advance of the science and art of Medicine in modern times is rightly attributed to the labours of the great medical discoverers. Vesalius re-opened the book of anatomy in the sixteenth century, Harvey demonstrated the circulation of the blood in the year of Shakespeare's death in the seventeenth, Sydenham within a stone's throw of this house restored the practice of the principles of Hippocrates, Jenner down in Gloucestershire proved the validity of vaccination, Sir J. Young Simpson discovered the anaesthetic power of chloroform at Edinburgh, Lord Lister was the founder of antiseptic surgery, Robert Koch led medical science in the paths of bacteriology, and a great company of

[1] The character of this necessity is set out in Simon's 'English Sanitary Institutions', 1890, and elsewhere.

medical practitioners in Europe and America put these new truths into practice. Their work has not only saved life on a scale undreamt of a hundred years ago, but it has made living a better thing. Much of their teaching has now passed beyond the control of a profession, and has entered into the common knowledge of mankind, forming, indeed, part of the very laws and customs of civilized nations. It was the doctors who taught us the characteristics of a sanitary house, of the necessity of a pure and sufficient water supply, of the advantages of drainage, of the ingredients of a wholesome dietary, of the infectious nature of certain diseases, of the principles of personal hygiene—now all matters of common knowledge.

Non-Medical Workers who advanced Medicine

A significant feature, however, of the progress of Medicine which we are liable to forget is the extraordinary contribution which has been made to its advance by scientific workers who have not been medical men. When Hippocrates died in 377 B.C., Aristotle was 7 years old. He grew up to be the founder of philosophical and biological science, described by Dante in the 'Divine Comedy' as 'the master of those who know'. He became the pupil of Plato at Athens, and subsequently the tutor of Alexander the Great. His influence on Medicine remained dominant for centuries. Then, in the thirteenth century, Roger Bacon, the English Franciscan monk, who was born at Ilchester, founded the experimental method of science, and gave to Medicine its supreme mode of research. Galileo, in his wonderful eighteen years at Padua, introduced into Medicine the laws of physics. Boyle in the seventeenth century, and Black in the eighteenth, brought chemistry into association with Medicine, and threw new light upon the whole question of respiration. Indeed, it has been well said that 'the development of the physiology of respiration

was almost exclusively the work of three mathematicians, two physicists, and five chemists'. Two famous artists, Albrecht Dürer and Leonardo da Vinci, advanced anatomy and even pathology by their accurate depiction, a matter of special importance when dissection of the human body was rare. Charles Darwin, like Aristotle, came of a scientific family, and underwent the preliminary medical studies, and, though he never became a medical man, altered the whole biological outlook of Medicine in his generation. Linnaeus and Buffon had described for us the morphology of plants and animals, but it was Darwin who interpreted it. The last and best example of all is Louis Pasteur, the French chemist, who discovered the origin of fermentation and infective processes, and created a new centre of gravity in medical science. There are a dozen non-medical men of the first order who left an indelible mark upon Medicine, and they are but examples of the truth that science has no frontiers, and that 'all sciences', as Pasteur declared, 'gain by mutual support'. I have spoken only of the great thinkers and master workers who have altered the science of Medicine. Of the non-medical men and women who have made enduring contribution to its art within the last century I need only mention as examples Sir Humphry Davy, Michael Faraday, John Dalton, Dumas, the French chemist, and Cuvier and Gay Lussac, Sir Edwin Chadwick, Florence Nightingale, Röntgen, Sir William Ramsay, Sir William Perkin, Ehrlich, and Madame Curie. Many of their inventions and discoveries —both social and physical—have revolutionized the art of Medicine as the great thinkers and explorers defined the principles of its science.

What is Disease?

Such a catalogue of names shows us the widening scope of Medicine and the increasing claims which it makes on collateral and ancillary sciences. Wider still is

the sphere of Preventive Medicine. All that concerns the physical life of humanity comes within its province, and my proposition is to invite Everyman to enter its kingdom. Before doing so, however, I want to attempt to define its purpose. Let me put it in this way. Disease is not an external entity or agent—a sort of devil outside ourselves—which we have to exterminate by direct methods of Preventive Medicine. There is no external thing we can call disease. It is something within the living organism. There is first the body of man, a complex organism, a part of Nature, grown and fashioned through the ages from a variety of organic and inorganic elements, with ancestral as well as individual physical and mental characters, developed in response to the necessity of functioning. The healthy life of the body depends upon the ordered sequence of a series of harmonious processes and functions. Secondly, there is the sum total of conditions which surround a man from infancy to old age, the forces of nature, climate, cold and heat, summer and winter, his house, his workshop, the human society in which he moves, his social, economic, and domestic circumstances, his food and drink, his habits, the strains and stresses of his life, the parasites and poisons, the agents of infection. All this is his environment.

Long ago Herbert Spencer said that perfect correspondence with environment would be perfect life. Any departure from that relation is the beginning of disease. *Disease is therefore the reaction of the human body to irregularities in its environment.* It is the disturbance of the harmony which is dis-ease. It is, as Metchnikoff said, a ' disharmony ' ; or, again, it has been described as the ' dissociation of the functional unity ' of the body. All this means that disease is not a dragon outside the body which we have to slay. It is a disharmony in the body which we have to avoid or correct. What we have to do is to equip and fortify the body (including the mind) of man against reactionary influences, or acclimatize

it to them, or modify the environment to suit its susceptibilities, or re-establish its disturbed functioning.

The purpose of Preventive Medicine is thus to improve environment, to develop innate capacity, to avoid disharmony in its early stages, in order to escape its later results in the body, and to prolong and enlarge man's days. Housing, water supply, drainage, wholesome and sufficient food, and industrial hygiene, are to create a *sanitary environment*. Human nurture, a maternity service, infant welfare, child hygiene, are designed to build a *healthy race*. Vaccines and anti-toxic serums are to create by immunity a *resistant body*. The destruction of infective agents, the segregation of infectious persons, disinfection, quarantine, avoidance of cough-spray or expectoration, are methods of *reducing mass infection*. Medical practice, clinics, dispensaries, hospitals, sanatoria, health insurance, are medical services for the early *diagnosis and treatment of disease*. There you have the great Articles of the modern practice of Preventive Medicine. 'Germs of disease' are important, but we must not go germ-mad. The essential thing is the healthy and resistant body of man, and the maintenance of his harmonious functioning, in relation to Nature and his environment, and in relation to human society. Progress depends more upon social and moral evolution than the advance of sanitary science, more upon wisdom than knowledge. The vastly improved health of the people in our generation has no doubt been partly due to the fuller application of sanitation, but still more to the forces of sociology and biology.

If we reflect upon these considerations we shall discover that the preservation of human life, which is another word for Preventive Medicine, is not a mere doctor's stunt, but springs from deep human instincts, and is established upon certain broad social conditions. It is, in fact, social in structure, though medical in inspiration. The groundwork of our civilization was laid during

the 400 years that we were the vassals of the Roman Empire. When the Romans came they found our island a wild place of marsh and forest and moorland, which had to be tamed and harnessed. Wherever the imperial legions went, they left behind roads, irrigation and water supplies,[1] and enduring laws. Every town was to be built on the model of Rome, and Rome herself was to be the heart and interpretation of the Empire.

I now turn to mention briefly, as illustrations, four non-medical groups of conditions which affect the health of a nation, and in the design and construction of which every individual, as future interpreter, has some share.

The Road

In summarizing the nature and causes of the wealth of nations in 1776, Adam Smith said that good roads were among the greatest of all national improvements.[2] He cited ancient China as an example of a country developed by its roads; and we know that the Roman roads issuing from the Forum traversed Italy, pervaded the provinces, and terminated only at the utmost frontiers of the Empire.[3] Sixteen centuries have not obliterated their mark in our own land. Then came the neglect of the Middle Ages, and it was only in the eighteenth century that England rehabilitated itself. The open track again became a road, indifferently supervised by the local farmer or parish surveyor; about 1750 the turnpike trusts were introduced, though not universally; and subsequently, by the genius of Telford and Macadam,

[1] In Egypt the very life of the country depends on its irrigation; in India irrigation has prevented famine; in America and Italy it has developed agriculture; and in many tropical countries it has, in conjunction with drainage, reduced malaria.

[2] 'The Wealth of Nations', 1776, I., p. 228.

[3] 'Decline and Fall of the Roman Empire', Gibbon, 1776, I., ch. ii.

the country recovered the value of a road system,[1] and in the nineteenth century the local authorities were made responsible by Parliament for the King's highway.[2] At the end of the seventeenth century there was increase of wheeled traffic (in substitution for saddle- and pack-horses), and in the following century of canal navigation. In 1829 came the evolution of the steam locomotive, and the development of the railway system frustrated the canals and postponed further reform of the roads.

A new situation arose owing to the invention by Daimler in 1885 of the *internal combustion engine*. The energy derived from the explosion resulting from the ignition of petrol vapour mixed with air was used to drive an engine, and this engine has been applied in the last twenty years to many uses—the motor-car, motor-cycle, motor-train, omnibuses, and taxi-cabs; ships, ambulances, aeroplanes; agricultural machines and commercial vehicles; pumping plants and electric lighting; the transport of troops, ammunition, and sick and wounded; and the conveyance of food. All forms of transport are within the compass of the internal combustion engine, and we are in the midst of what has been called 'the mechanical civilization of the world', a new era both of communication and of industrial development largely due to this invention.

Whatever may lie before us, one thing is certain—the progress of civilization hitherto has been primarily dependent upon intercommunication. In the modern as in the ancient world this is the first element of progress. It encourages the development of the periphery; it is advantageous to the centre; it opens markets; it provides

[1] The improvement of the surface of the road by Macadam has been further developed, and dust-free paving has reduced atmospheric pollution.

[2] 'History of England after 1815', Spencer Walpole, I. 73–82. 'The Road', Hilaire Belloc, 1923. 'Lives of the Engineers', S. Smiles. 'The King's Highway', S. and B. Webb.

for national defence; it secures government; it spreads knowledge and advances science. It is only because we have never known its absence that we are forgetful of the inherent and essential value of its presence. A country without roads, or other means of ready intercommunication, is a country in which there can be no organized system of Preventive Medicine. The use of the road, the railway, the steamship, the telegraph, the telephone, the internal combustion engine, the aeroplane, and 'wireless', has changed the face of England. It has made actual the enormous potential wealth and capacity of the country. It has, almost beyond our imagination, enlarged the social life of the people. It has brought them into sunlight and fresh air. It has carried them to and from their work. It has furnished their tables with nourishing food. It has spread newspapers and books before them, filling their minds with new interests and enabling them to enter a wider citizenship. It has revolutionized both war and peace, and 'covered the world with a network of wonderful hours'. It is the first great contributor to the saving of human life and the postponement of death. Every man who extends its scope or builds its ways is contributing to make straight a highway of health. He is an interpreter.

Political Power

Having means of association of men, the next requirement was political power. Every advance in knowledge increases the capacity or opportunity of those who control affairs, but it yields no results unless the community insists that it shall. The Industrial Revolution—a process rather than an event—is the great divide between the eighteenth century and the modern period. There has been steady pressure upon Parliament in behalf of reform, particularly since the Reform Bill of 1832. It has been the story of the building up of a new world, a wholly new type of society, infinitely more

complicated and interdependent in its parts, more full of potentialities for progress or disaster than anything the world has before seen. It has been the work of all classes and of all parties, whether in co-operation or in conflict.[1] The Municipal Corporations Act of 1835 altered the structure of English local government by placing the responsibility of action upon an elected body in corporate towns.[2] The population had moved from the rural districts into the town; the Act of 1835 concentrated the powers of governance in the town council. Thus Local Government became an organized policy, which in due course was not only made to apply to all districts, whether urban or rural, but was also widened to comprise comprehensive measures of social reform, including sanitation and public health (Public Health Acts, 1848, 1875, et seq.). Contemporary with this Parliamentary policy, and growing up alongside it, was the Trades Union Movement. Parliament began to exercise its powers with the elementary requirements of sanitation, factory supervision, and hours of labour; the trade union began with rates of wages and methods of remuneration.[3] In both, there soon came to be certain national minima of aspiration. 'Every society is judged and survives' said a former Prime Minister (Mr. Asquith) 'according to the material and moral minima which it prescribes to its members.' The Royal Sanitary Institute was founded to express and enforce the minima of the public health.[4]

Here, then, were the political instruments, but where

[1] 'British History in Nineteenth Century', G. M. Trevelyan, 1922.

[2] Cambridge Modern History, Vol. XII., 'The Latest Age', pp. 733 et seq.

[3] 'History of Trade Unionism', by S. and B. Webb.

[4] At a meeting held in St. James's Hall, London, in July, 1876, at which the Duke of Northumberland presided, it was resolved 'That in the opinion of this meeting the sanitary condition of this country is still very unsatisfactory, and that further legislation is necessary with a view to its improvement; and that for the purpose of

were the ideas? Whence came the inspiration to employ the instruments? Apart from a few isolated medical pioneers, such as Percival of Manchester, the doctors were not available, for no organized medical service existed. It was Jeremy Bentham (1748–1832), William Cobbett (1762–1835), Robert Owen (1771–1858), Edwin Chadwick (1800–1890), and Lord Shaftesbury (1801–1885) who were the men who moved England to undertake sanitary reform. These men were not doctors. How they came to be the pioneers of public health and industrial welfare is one of the great stories of the nineteenth century. Medical men had pointed out the way, and were called in evidence before Parliamentary and other committees of enquiry,[1] and, later on, medical men served as Special Commissioners and inspectors, and eventually as medical officers of health and civil servants (Arnott, Kaye, Southwood Smith, Simon). But the originators of public opinion and the advocates and exponents of sanitary legislation were non-medical men, who expressed the aspirations of the people. It has always been so, and is so to-day—and it is right that it should be so. Sometimes the non-medical advocate follows a false trail and gets away from the facts of the position. But he takes the broad medical findings, and transmutes them into political power. He is chosen by the people to do this, and in accordance with their equipment and will, and his own, he interprets them. It is a process

collecting and imparting information upon all matters connected with the subject of public health a society be now formed, to be styled "The Sanitary Institute of Great Britain"'. The founders hoped to secure the enforcement of the laws of health, and aspired to diminish the death-rate and to promote the happiness of the people by improving their physical and moral condition. They had a municipal ideal in their mind, which included the conviction that every poor person inherits a natural right to be provided at a cost within his means with good water, good air, and a healthy dwelling to live in.

[1] 'The Private Practitioner as Pioneer in Preventive Medicine', 1926.

of social and political evolution, in which the major part always has been, and will be, *education*.

Economic Development

There is a third factor which the practitioners of Preventive Medicine must continually bear in mind—the economic state of the community. Legal and constitutional power is necessary for good government, but equally essential is financial resource. 'Economic processes are primarily physical in the efforts they evoke and in the need they satisfy; the expenditure and recoupments of physical energy constitute the first and most prominent aspect of industry.'[1] A people well housed, well fed, and working in a sanitary environment, should be a healthy people. But these three conditions cost money, and the purchaser must have the means of buying; for the State should only provide the communal services which the individual cannot provide for himself.

Let me name two illustrations of the economic factor; they shall be quite fundamental, and essentially related to health. First, there is the food question. In 1801 the population of England and Wales was about nine millions, and there were five large towns, so that the people lived in the country, near their food supply. Now the population is 39 millions, and there are 105 large towns and 157 smaller ones. Hence much of the food supply must be brought, as in fact it is brought, from the ends of the earth. An ordinary Englishman's breakfast may consist of a cup of tea with sugar, bacon and eggs, some bread and butter, and an apple or banana. His tea is from the East Indies, Ceylon, and China, and the sugar from Europe and the West Indies. His ham is from across the Atlantic or from Denmark; his egg is from England, Ireland, Denmark, or Holland, or, if not very recently laid, from Egypt or even China. His

[1] 'Work and Wealth', J. A. Hobson, 1914, p. 13.

bread is made of wheat from the granaries of the Empire over sea, and his butter is from the Low Countries, or Australia, or New Zealand. The raw fruit comes from the West Indies or America, or, still more likely, from Spain. A dozen different nations are providing more than half of the Englishman's breakfast; and only 18 per cent of his bread and butter is home-produced. Truly, we are members one of another.

There are many aspects of this food question—supply, delivery, variety, quantity, quality, usage, wholesomeness. Above all, there is cost. Though the well-being of a people is measurable by many other factors than food, we may say in a general way that nutrition is the basis of a healthy people. There can be no doubt that the immense improvement in the dietary of civilized peoples has exerted a beneficial effect upon their health, powers of resistance, and capacity. A well-fed soldier or workman has increased potential energy. My point here is, however, the simple one that the improved nutrition of the people has been due to far-reaching economic circumstances, the organization of supply, and the power to purchase it. This is one of the principal factors in modern Preventive Medicine.

My second economic example has relation to health insurance. The early history of insurance in this country is partly one of co-operative protection by friendly societies and similar bodies, and partly one of the commercial developments of life assurance. In both, it is a question of deferred pay or immediate benefit on a basis of monetary value of life and capacity. We have now in existence a vast insurance service initiated, or implemented, by the State (1911–1925).[1] It consists of five

[1] A similar system has been established in Germany (1882–1889). See 'Bismarck', by C. Grant Robertson, 1918, pp. 352–393, and 'Modern Germany', by W. H. Dawson. In the U.S.A. somewhat similar arrangements obtain, but they are organized by prudential societies, employers, or the separate States of the Union.

branches which, though not strictly comparable with each other, form parts of a comprehensive scheme:

1. Health insurance. (National Health Insurance Acts, 1911–1924.)
2. Insurance against unemployment. (Unemployment Insurance Acts, 1911–1925.)
3. Insurance against accidents. (Workmen's Compensation Acts, 1906–1925.)
4. Old Age Pensions. (Old Age Pensions Acts, 1908–1924.)
5. Pensions for insured persons, including mothers and orphans. (Widows, Orphans, and Old Age Contributory Pensions Act, 1925.)

These five forms of insurance tend to ensure in different ways the fulfilment of preventive measures against invalidity and premature mortality. Being mainly contributory schemes, they have the further advantage of anchoring a man's interest in the financial stability of the State, in which he becomes a shareholder. They are also a method of personal saving and security.[1]

[1] It is instructive to observe the enormous growth of direct personal saving which has taken place since 1916 under the National Savings Committee. The medium of investment offered by the Savings Movement is the National Savings Certificate. Savings Certificates are now held by many millions of our population. Indeed, it is no exaggeration to say that they have attained a popularity unequalled by any similar security in any country of the world. The total number of Savings Committees on December 31st, 1925, was 1,506, and the total number of Savings Associations 22,207. The total number of Savings Certificates sold from February, 1916, to December 31st, 1925, was 753,757,211 (cash equivalent £588,615,537). Although money invested in Savings Certificates may be withdrawn at any time with interest to date, approximately £460,000,000, including interest, still remains invested. Under the Post Office Savings Certificates in 1923–1924 the amount reached £45,000,000. There are also 1,200 incorporated building societies and 2,500 industrial and provident societies in which savings are invested. See also 'Insuring, Saving, Spending', edited by Sir W. Schooling, 1925.

The influence of insurance in Preventive Medicine acts in two ways. First, it rehabilitates the insured person in the community. It places him in an economic position to carry out those manifold health requirements which modern medical experience has shown to be necessary for the avoidance of disease. The trouble in the past has been that the individual often *could* not do what we advised him to do. Insurance provides the necessary facilities which the unaided individual cannot furnish by or for himself. Thus, health insurance is not fanciful or redundant, nor yet something outside the effective organization of the public health. It is an integral part of the practice of Preventive Medicine for the great mass of the people. But, secondly, health insurance creates direct benefits (medical, surgical, dental) which are in themselves preventive as well as curative, and insurance against accidents establishes incentives to safeguarding and caution. I am convinced that our present national scheme of insurance is an extremely important means of national well-being. Of course, it has imperfections, and it is not yet fully assimilated into our national polity, but it is beginning already to produce the designed effects.[1]

Everyman's Social Habit and Custom

'Our experience' said Robert Burton 'is our best physician'; and more effective and widespread than any other influence on personal and public health is the social habit, fashion, and custom of every man and every woman.

> 'Tell me, when was Custom born,
> Yester eve or yester year?
> Days and years she knoweth not,
> She was always here.'

It is this universality of custom which gives it predominance. Lecky tells us that: 'It exercises over great

[1] See Report of Royal Commission on National Health Insurance, 1926.

multitudes an almost absolute empire, regulating their dress, their education, their hours, their amusements, their food, their scale of expenditure; determining the qualities to which they chiefly aspire, the work in which they may engage, and even the form of beauty which they must cultivate. It is happy for a nation when this mighty influence is employed in encouraging habits of life which are beneficial, or at least not gravely prejudicial to health. Nor is any form of individual education more really valuable than that which teaches the main conditions of a healthy life and forms those habits of temperance and self-restraint that are most likely to attain it.'[1] I propose to mention some illustrations of this influence.

(*a*)

If we compare the life of the English people in the first half of the eighteenth and nineteenth centuries, we shall find that in the earlier century they lived in a rural England as contrasted with an urban one, and this gave them many of their characteristics. There was one feature of their life which left an indelible mark, namely, their spirit-drinking habits. They became a nation of tipplers. 'Hard drinking was the vice of the nation from the highest to the lowest.'[2] In 1733 'England touched a lower depth of inebriety than ever known before or seen since. The prevailing intemperance was the most momentous event of the eighteenth century.'[3] They paid for it in the highest mortality of which we have annual record. It is admitted that the excessive consumption of alcoholic beverages, especially those containing a high spirit percentage, is injurious to health. There can be little doubt that an habitual and continuous consumption which never reaches the degree of excess

[1] 'The Map of Life', W. E. H. Lecky, 1899, p. 12.
[2] Spencer Walpole, 'History of England in 1815', I. 136.
[3] Scarisbrick's 'Spirit Manual', 1891, pp. 39–40.

may also be deleterious, and, though a greater degree of moderation now obtains than in the eighteenth century, a substantial amount of ill-health and some mortality must still be attributed to drinking customs. Happily in recent times, both in England and America, there has been an increase in sobriety, alongside an enormous development in the drinking of tea, coffee, iced and aerated waters, light beers, and mineral beverages, and this, whatever be its minor disadvantages, is preferable to the heavy spirit-drinking of the eighteenth century.

In the last fifty years there has been remarkable improvement in the dietary of the people, which has become more attractive, varied, appetizing and nutritious. The daily eating of meat has become the rule rather than the exception, and many prepared meat foods are manufactured and now obtain a ready market. The development of the sweet and chocolate trade, of jams, spices, salads, and biscuits, has been even greater. Large quantities of fresh fruit and fish are now consumed by all classes; they are no longer the luxury of the rich. There are not a few features of the supply, purchase, and consumption of food which are open to criticism—such as the disadvantages of insufficient green vegetables, milk and milk products, and a surfeit of meat—but, on the whole, and taking a broad view, there has been an enormous improvement in the wholesale food supply and in the dietary of the people. A famous trainer of racehorses has said, 'Feeding wins more races than actual training.'

(*b*)

The last three hundred years have witnessed many strange expressions in the dress of men and women.[1]

[1] 'Shakespeare's England', Vols. I. and II. 'Social England', H. D. Traill, Vols. IV., V., and VI. Both these books are full of evidence of the social evolution of the English people which has by slow degrees given them health.

Fancy and fashion have played a greater part than convenience and health. It may well be that in the earlier times men's dress, at least, was more elegant than nowadays, but, speaking generally, there has been a steady trend towards simplicity and common sense. It cannot, I think, be doubted that the present dress of women is lighter and looser than formerly, and on the whole more conducive to health and free movement. The trailing skirt, like the wig, has vanished. More attention is paid than was the case fifty years ago to personal appearance apart from dress, and to bodily cleanliness. The mischievous window tax of the eighteenth century has been abolished,[1] and the domestic bath has been installed. The sale of soap has increased, and the toothbrush and dentifrices are more widely used. Particularly noticeable is the disappearance of the unpleasant habit of promiscuous spitting. All this means a cleaner and healthier life in almost every home in the land.

(*c*)

A third custom which is exerting a favourable effect on health concerns amusements. Golf, tennis, football, cricket, open-air sports, and dancing have, happily, an immense vogue, though there is great need for increased provision of playing fields. The people are becoming more appreciative every year of life in the fresh air and sunlight. The immeasurable advantages of the open air were first inculcated in the schools twenty years ago, and the children thus habituated are now adults, with children of their own. The week-end habit, the enjoyment of the seaside and sea-bathing, cheap excursions by train or automobile on improved roads, extended

[1] The window tax was imposed in 1696 and repealed in 1851. It led people to block up their windows and reduce light and air in their houses (' London Life in the Eighteenth Century ', M. D. George, 1925, p. 77).

travel, an annual holiday, and what is called the 'emancipation of women', are having an enormous effect on personal and public health.

(*d*)

Lastly, remarkable progress is being made in the education of the people in health. Simple hygiene is being taught, and in fuller measure practised, in all the State schools; there is a great increase in the means of instruction by classes, lectures, lessons, and innumerable handbooks; and a score of voluntary health societies are spreading the good news by demonstrations, exhibitions, 'health weeks', and millions of leaflets. In this task of propaganda and public education the newspaper Press is playing an invaluable part; even its advertisement pages often contain much sound doctrine and common-sense precept. No doubt there are exceptions, and the most portentous rubbish is still to be seen in certain quack advertisements which trade on the credulity of ignorant people. But there has been a great awakening, an amazing currency of health ideas, an ever-widening understanding of national and international well-being.[1] There is no public duty of more consequence than the education of the English people in health of body and mind.

Conclusion

I submit that the deduction to be drawn from these observations is that other forces than sanitary science in its narrow sense have played a large part in the present condition of the public health. Four illustrations have been mentioned: (*a*) means of intercommunication, (*b*) political power, (*c*) economic development, and (*d*) social

[1] See 'Public Education in Health', 1926 (H.M. Stationery Office, price 6*d*.).

habit and custom. Others might with equal advantage have engaged our attention, but my purpose will have been served if I have encouraged or even helped Everyman to see his part in providing and maintaining a high standard of health, physical fitness, and mental capacity, which is indispensable alike to the nation's efficiency and to the discharge of our imperial and international obligations. There is no public question of more vital importance, nor one in which the co-operation of Everyman is more essential. He is to be the future interpreter of Preventive Medicine. His direct obligation is twofold. He should safeguard his own health and that of those dependent upon him. Any degree of deliberate neglect is culpable, and in some degree an offence against the State. His indirect duties require that he should not expose his neighbours or fellow workmen and associates to any avoidable risk by neglect of his own health ; and to assist him in this duty the facilities provided by his employers and the local authority ought to be used freely and fully, for to accept the assistance thus provided cannot expose his self-reliant spirit to criticism, though to decline may. He should also be active as a true citizen, supporting the State in the ever-widening interest and responsibility which it takes in the maintenance of the public health, and for which he pays part of the bill. Lastly, as interpreter of Nature he should seek to increase his knowledge of her ways. Whatever other learning he can do without, he cannot long survive the continued disregard of her laws.

INDEX